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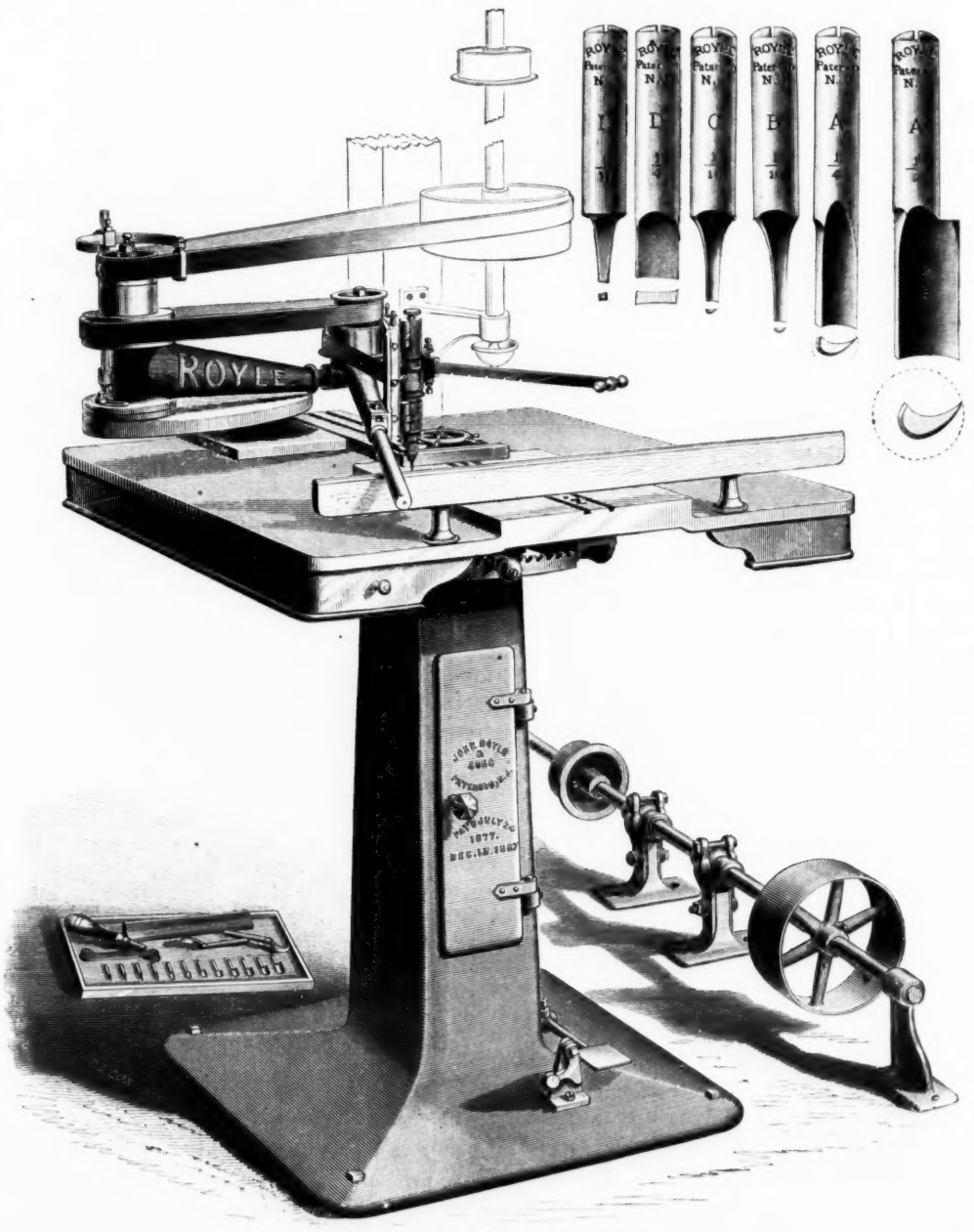
Radial Arm Routing Machine.

The accompanying illustration represents a radial arm routing machine, brought out by John Royle & Sons, Paterson, N. J. It is a somewhat simpler machine than the one illustrated in our issue of January 31st, 1889, and for working qualities embodies all the points of the latter, except that of cutting straight lines; although straight lines can be cut with the radial arm machine, it requires skill of the operator to do so in guiding the cutter along the line to be routed; otherwise the machine is very effective, and is designed for routing zinc or process engravings, electrotype or stereotype plates, either blocked or unblocked, brand letter blocks, wood cuts, pine tints or show bill cuts, label work, blocks for the manufacture of fine paper hangings, and may be used equally well on brass, embossing dies, book plates, soap dies, and for other purposes.

The general features of the machine are as follows: The working parts of this machine are built upon an iron bed plate or table, which is rigidly supported by a heavy broad-based iron pedestal, in the interior of which ample closet room is arranged for tools.

The cutter-bar at its further end is connected with and near the free end of a horizontal radial arm, so arranged as to admit of universal movement to the forward end of the cutter-bar. The latter at its forward end is formed as a handle, which rests on a wooden guide shown near the front of the machine. With this arrangement an even depth to which the surface which is to be cut down is secured. This handle is guided by the left hand of the operator; and for his right hand there is arranged an extensible handle that engages with the radial arm at its outer or free end, enabling the operator to control perfectly the movement of the cutter.

The cutter-bar carries a vertical slide shown towards the front of the machine; the movable portion of the slide carries the cutter spindle. The purpose of the slide is to adjust the spindle for the depth of the cut, which is accomplished by turning the handle shown at the top of the slide to the left of the spindle; this handle is attached to a screw which engages with the movable part of the slide.



RADIAL ARM ROUTING MACHINE.

The cutter is secured in the spindle by the means of a gripping collet or steel chuck, the closing and opening of which is accomplished by turning the milled head shown on top of the spindle; this head is attached to a screw passing lengthwise through the spindle. The important feature embodied in the construction of the chuck is that it secures the cutters concentrically, and invariably presents their cutting edge to the work. The spindle runs from 12,000 to 14,000 revolutions per minute without causing tremulous motions to the machine or impairing its usefulness. The spindle is made of hardened steel; the bearings are of phosphor bronze, in the form of bushings, which are compressible on their circumference. This secures a means of taking up any looseness in the bearings caused by wear.

The gripping device for holding the work has a powerful forward and downward movement, which, while securing the work, tends to press it firmly to the surface of the bed plate. This device is universal in its ready application to the various kinds of work to be done. No special attachment or change is required for quickly and firmly securing the thinnest plate or the most shapeless block. One jaw of this gripping device is shown just behind the cutter; this jaw is quickly moved in any desired position by means of the small horizontal hand-wheel directly above the jaw. The other jaw is hidden by the wooden cutter-bar guide; this jaw is for the purpose of clamping or releasing the work, and is operated by the handle projecting from under the edge of the table.

All chips are effectually removed from the surface of the work by a strong current of air put in motion by the propeller-shaped blades at the lower end of the spindle.

The starting and stopping of the machine is under perfect command of the operator, by means of a convenient foot-pedal that controls the belt shipper. This feature is important in avoiding slips or cutting into the lines of narrow and converging spaces.

Oil reservoirs are attached to all bearings for lubricating purposes, and drips are so shaped within the pulleys of the machine as to effectually prevent oil being thrown from them by the centrifugal force.

The machine is made to take blocks from the smallest size up to thirty-four inches in width, and of indefinite length. The table top is entirely free from obstructions, thereby affording every facility for handling, if desired, very large blocks.

The illustration also shows the cutters on an enlarged scale, nearly full size. The fluted cutters marked *A* are for cutting wood, soft metal, zinc, etc. The cutters marked *B* are for cutting hard zinc. The half-round cutters *C*, and the two-edged cutters *D*, are for cutting brass.

The floor space required for this machine is 36x61 inches. The dimensions of table are 36x41 inches. The weight of the machine is about 650 pounds; the length of the countershaft is 6½ feet; the driving pulley is 5 inches diameter and 2¾ inches wide; the main belt should be 1¾ inches wide. The speed of countershaft should be 625 revolutions per minute. About one-half horse-power will drive the machine.

Some Remarks about Boilers and their Surroundings.

BY ENGINIST.

There are a good many boilers being operated in this country to-day with only one means of feeding. They are like a building in a large city with only one means of exit—windows and all other possible places of exit securely barred. Every boiler should have two means of feeding, as much as every building should have more than one means of egress in case of fire.

It may be urged that an engineer will stop short of taking chances if his single means of feeding refuses, without apparent cause, to work. There are engineers that will do this, but they will not all do it. Pumps and injectors will sometimes balk, and by a little coaxing will take up their duties again. And almost any engineer will take just a little—not much—chance of imminent conversion before he will stop the mill. Now with both pump and injector, each of sufficient capacity to feed the boiler, he puts the one that has been resting at work, and lets the other sulk it out, or flatters it into resuming operations. Then when one or the other is permanently disabled it is mighty handy to have the other shoulder the responsibilities of both during repairs.

I suppose in the majority of instances the lack of two means of feeding a boiler is the fault of the proprietor. The pump works right along, and he don't see any reason why it shall not always do so. If his engineer clamors for a second feeder he considers him an extravagant fellow who would spend all the earnings of the concern in the engine and boiler-room. It is the weakness of those who don't know much about such things to think that, because a pump or injector works to-day, it will always work.

Every engineer knows that such devices will strike without due warning, once in a while, and again they will quit work for good and sufficient reasons. Many an engineer goes without the second means of feeding his boiler because he cannot get it—a very good reason. Then, when his pump gets tired, and the mill is shut down during the most important rush of the season—no pump or injector ever made quit work when business was slack—the proprietor pays the bills and probably discharges the engineer.

The majority of boilers have but one safety valve. A safety valve is an excellent thing in its way, and safety valves are of all sorts and conditions—good, bad and indifferent; mostly bad and indifferent. Like a

watch, they are all likely to stop; sometimes they stop pretty tight. I saw one tried not long ago, and it was pretty well demonstrated that it would have taken about 2,000 pounds pressure per square inch in the boiler to have raised it from its seat. I might add that it was tried after the boiler had quit business and the largest piece left of it had journeyed down the road a quarter of a mile.

I haven't anything to say in favor of an engineer who lets a safety valve get into a condition where nothing short of a battering-ram will move it; but it is a satisfaction to the careful engineer to know that, if one safety valve gets fast, in all human probability the other one will attend to duty. The engineer's feelings, under these circumstances, are akin to those of the General, who, in making a doubtful attack, sees the way for retreat open.

Grate bars are rather important factors in a boiler furnace. A broken one will continue to let a lot of good coal into the ash-pit, and a lot of cold air into the tubes. The coal that drops through into the pit is mostly lost, and the cold air gets heated at the expense of a good slice from the coal pile. I have known an engineer try to get a new set of grate bars until their cost had been lost three or four times, all the while being grumbled at for burning so much coal.

A friend of mine had a boiler set four years ago by a mason who had no conception of the requirements of the job. He built light single walls, which in process of time—not a very long time, for there were no means provided for contraction and expansion—cracked in several places. Two months ago he had this boiler re-set in a proper manner, and the saving in fuel is said to be twenty per cent. The lesson of this is to have the boiler properly set in the first place. Cheap work in boiler setting never pays. Setting a boiler is a job that was never done too well.

When horizontal tubular boilers are sold by the horse-power on the basis of twelve or fifteen feet heating surface per horse-power, there is strong temptation to get in too many tubes. It don't take many feet of three or four inch tube to give twelve or fifteen feet of heating surface. Some boiler makers are entirely honest in this respect; but, alas, some are not. I have seen and heard of boilers where, with no other apparent purpose than to increase the commercial horse-power, the tubes were placed so high as to so reduce the steam room that at every pulsation (from the engine) in the steam pipe the boiler would seriously strain the setting and steam connections.

Then, again, tubes are placed so near the shell as to make filling up of the space possible, and to leave no room for cleaning.

Odontics, or the Theory and Practice of the Teeth of Gears.

By Geo. B Grant.

FIRST PAPER.

26.—OBLIQUITY OF THE ACTION.

When a pair of teeth bear upon each other, the direction of the force exerted between them is that of the common normal $O\,p$, Fig. 17, and passes through the pitch

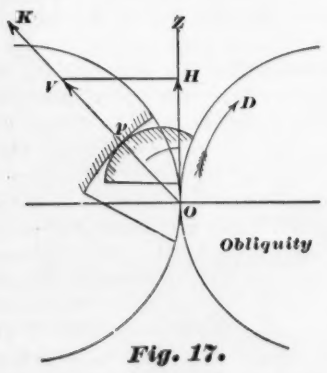


Fig. 17.

point O. Except when the point of contact is at the pitch point the direction of the pressure will deviate from the normal to the line of centers by the angle of obliquity $Z\,O\,p$, and with many forms of teeth the angle is never zero.

The force exerted between two teeth at their point of contact is found by laying off the tangential force $O\,H$ with which the driving gear D is turning, and drawing the line $H\,V$ parallel to the line of centers, to find the force $O\,V = P\,K$. It is proportional to the secant of the angle of obliquity, and increases rapidly with that angle.

The chief influence of the obliquity is upon the friction between the teeth, and consequent inefficiency of the gear, and upon the destruction by wearing. It is particularly important upon the approaching action, and a gear that is otherwise perfect may be inoperative on account of excessive obliquity.

Although the direct pressure of the teeth upon each other at their point of contact will vary with the obliquity, the tangential force exerted to turn the gear is always

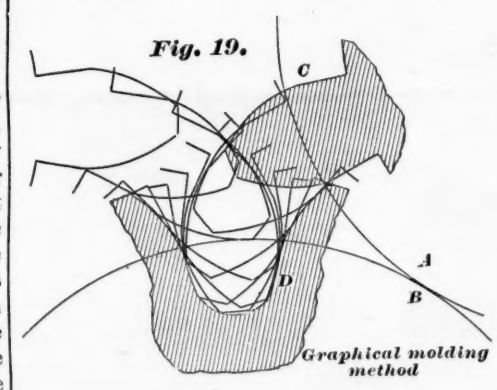


Fig. 18.

Fig. 19.

uniform. Leaving friction out of the calculation, the two gears of a pair always turn with the same force at their pitch lines.

The obliquity of the action has an effect upon the direction and amount of the pressure of the gear upon its shaft bearing, but the usual variation is of little consequence.

It is desirable that the pressure between the teeth should be as uniform as possible, not only in amount, but in direction, and excessive obliquity is to be carefully avoided.

27.—CONSTRUCTION BY MOLDING.

The mode of action of the conjugate teeth upon each other, suggests a process by which a given tooth can be made to form its conjugate by the process of molding.

The given tooth, all of its normal sections being of some odontoidal form, is made of some hard substance, while the blank in which the conjugate teeth are to be formed is made of some plastic material. The shafts of the two wheels are given, by any means, the same motions as if their pitch surfaces were rolled together. The hard tooth will then mold the soft tooth into the true conjugate shape.

It matters not what shape is given the molding tooth, if its sections are all odontoidal, and a twisted or irregular shape will be as serviceable as the common straight tooth.

This process is continually in operation between a pair of newly cut teeth, or between rough cast teeth, until the badly matched surfaces have been worn to a better fit, but it is too slow for ordinary purposes, and is of little practical value.

Gears can be formed by this process, by rolling a steel forming gear against a white hot blank, but the process can hardly be called practical.

28.—MOLDING PLANING PROCESS.

Although the described molding process is of limited practical value, having but one direct application, it leads to a process of great value when the tooth is straight or of such a shape that it can be followed by a planing tool, its normal sections being alike.

The originating tooth is fixed in the shape of a steel cutting tool C, Fig. 18, which is rapidly reciprocated in guides G, in the direction of the length of the tooth, as the two pitch wheels A and B are rolled together. Although the tool has but a single cutting edge, its motion makes it the equivalent of the molding tooth, and it will plane out the conjugate tooth D by a process that is the equivalent of the more general molding process.

A simple graphical method is founded upon this molding process, the shaping tool taking the form of a thin template C, Fig. 19, that is repeatedly scribed about as the pitch wheels are rolled together, the marks combining to form the conjugate tooth curves D.

This mechanical process has the decided advantage over the process of construction by points (24), that the tooth is formed with a correct fillet (44), and is much stronger. The dotted lines show the tooth that would be constructed by points.

The only practicable method for forming the line of action when this method is used is by observing and marking a number of points of contact between the teeth. This method is applicable to all possible forms of spur teeth, either straight, twisted or spiral. It can be practically applied only to the octoid form of bevel tooth.

On account of the fillet (44) that is formed by this process, the tooth space cannot be used with a mating gear having more teeth than that of the forming gear, although it belongs to the same interchangeable set. The tooth space of the figure will not run with a tooth on a pitch line larger than the pitch line A.

Therefore the rack tooth must be used as the forming tooth, to allow of the use of all gears of the set up to the rack. Gears of the set thus formed will not work with internal gears.

29.—LINEAR PLANING PROCESS.

A second planing process, quite distinct from the molding process of (27), is founded upon the fact that the tooth curves are in contact at a single point which has a progressive motion along the line of action.

Therefore if a single cutting point p, Fig. 20, is caused to travel along the line of action with the proper speed relatively to the speed of the pitch line, it will trim the tooth outline to the proper odontoidal shape.

The figure shows the application to the involute tooth, the path of the cutting point being the straight line $l\,a$, and its speed being the speed of the base line $b\,l$.

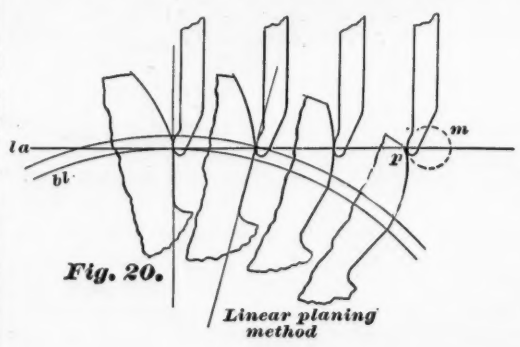


Fig. 20.

When the cutting point follows the circular line of action with a speed equal to that of the pitch line, it will plane out the cycloidal tooth curve.

This process is applicable to all possible forms of gear teeth, either spur or bevel, in either external or internal contact.

When the curvature of the odontoid will permit, the milling cutter may take the place of the planing tool, and is the equivalent of it.

30.—THE RACK ORIGINATOR.

The molding planing process of (28) supplies a means for easily and accurately producing an interchangeable set of gears or cutters for gears, and it is best applied by means of the rack tooth as the originator.

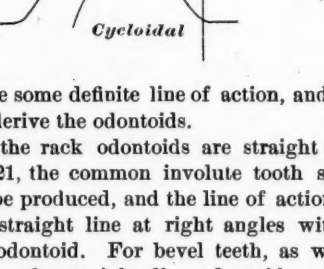


Fig. 21.

All four curves of the rack tooth being alike, the tooth is easily formed, particularly for the involute or the segmental systems, and it is a matter of less consequence that the curves shall be of some particular form, if care is taken that it is odontoidal.

It has been taught, and it is therefore sometimes considered, that any "four similar and equal lines in alternate reversion" will answer the purpose, but it is necessary that the four similar curves shall be odontoids. Four circular arcs, with centers on the pitch line, will answer the definition, but are not odontoids.

31.—PARTICULAR FORMS OF THE ODONTOID.

The odontoid, as so far examined, is undefined except as to one feature of the arrangement of its normals, and to bring it into practical use it is necessary to give it some definite shape. This is most easily accomplished by choosing some simple curve for the rack odontoid, and from that making an interchangeable set. A more correct but much more difficult method would be to

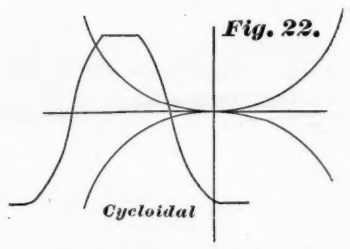


Fig. 22.

choose some definite line of action, and from that derive the odontoids.

If the rack odontoids are straight lines, Fig. 21, the common involute tooth system will be produced, and the line of action will be a straight line at right angles with the rack odontoid. For bevel teeth, as will be shown, the straight line odontoid produces the octoid tooth system, while to produce the involute system it is necessary to define the line of action as a straight line, and derive the system from that.

If the rack odontoids are cycloids, as in Fig. 22, the resulting tooth system will be the cycloidal, commonly misnamed the "epicycloidal" system. The line of action will be a circle equal to the roller of the cycloid. If the rack odontoids are segments of circles from centers not on the pitch line, but inside of it, as in Fig. 23, the tooth system will be the segmental, and its line of action will be the loop of the "Conchoid of Nicomedes."

If we choose a parabola for the rack tooth, as in Fig. 24, the parabolic system will be formed with its peculiar "hour glass" line of action.

Only three of these tooth systems are in actual use, the involute and the cycloidal for spur gears, and the octoid for bevel gears only, and we will therefore confine the application of the theory to them.

Only one of the systems in common use for spur gears, the involute, should be in use at all, and we will pay principal attention to that.

The segmental system would be superior to the cycloidal, and in many cases to the involute; but as there is already one system too many, we will not attempt to add another.

32.—THE ROLLED CURVE THEORY.

If any curve R, Fig. 25, is rolled on any pitch curve $p\ l$, a point p in the former will trace out on the plane of the latter a curve $s\ p\ z$, called a rolled curve.

The line $p\ q$, from the tracing point p to the point of contact q, is a normal to the curve $s\ p\ z$, and, as all the normals are arranged in "consecutive" order, that curve must be an odontoid. The converse of this statement is also true, that all odontoids are rolled curves; but the fact is generally very far fetched and of no practical importance.

It is also a property of all such curves that are rolled on different pitch lines, that they are interchangeable.

This accidental and occasionally useful feature of the rolled curve has generally

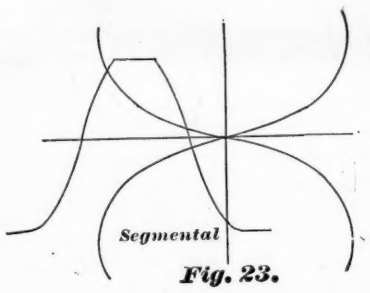


Fig. 23.

been made to serve as a basis for the general theory of the gear tooth curve, and it is responsible for the usually clumsy and limited treatment of that theory. The general law is simple enough to define, but it is so difficult to apply, that but one tooth curve, the cycloidal, which happens to have the circle for a roller, can be intelligently handled by it, and the natural result is, that that curve has received the bulk of the attention.

For example, the simplest and best of all the odontoids, the involute, is entirely beyond its reach, because its roller is the logarithmic spiral, a transcendental curve that can be reached on by the higher mathematics.

No tooth curve, which, like the involute, crosses the pitch line at any angle but a right angle, can be traced by a point in a simple curve. The tracing point must be the pole of a spiral, and therefore the tracing of such a curve is a mechanical impossibility. A practicable rolled odontoid must cross the pitch line at right angles.

To use the rolled curve theory as a base of operations will confine the discussion to the cycloidal tooth, for the involute can only be reached by abandoning its true logarithmic roller, and taking advantage of one of its peculiar properties, and the segmental, sinusoidal, parabolic, and pin tooth, as well

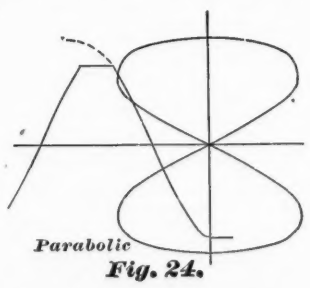


Fig. 24.

as most other available odontoids, cannot be discussed at all.

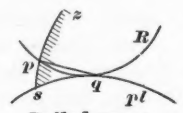
33.—MATHEMATICAL RELATION OF ODONTOID AND LINE OF ACTION.

In Fig. 26 the odontoid on the pitch line $p\ l$ is connected with the line of action $l\ a$, by the relations $P\ T = p\ t = y$, and $T\ S = t\ O = x$, where $P\ S$ is the normal to the odontoid at the point P, $T\ S$ is a tangent to the pitch line at the intersection of the normal, and $P\ T$ is a normal to the tangent.

When any odontoid is given by its equation, that of the line of action can be found by a process of differentiation, and when the line of action is given by its equation, that of the odontoid can be found by a process of integration.

These processes, for the general case where the pitch line is curved, are quite intricate, but when the pitch line is a straight line, they are simple, and may be worked as follows.

To get the equation of the line of action from that of the given rack odontoid, arrange the equation of the odontoid in the form $x = f(y)$, and put its differential coefficient $\frac{d\ x}{d\ y}$ equal to $\frac{y}{x}$. Thus, the equation of the straight rack odontoid of the involute



Rolled curve

Fig. 25.

system is $y = x$ tan. A, from which $\frac{d\ x}{d\ y} = \frac{1}{\text{tan. } A} = \frac{y}{x}$, and $y = \frac{x}{\text{tan. } A}$ is the equation of the straight line of action at right angles to the odontoid. Again, the equation of the cycloid being $x = \text{ver. sin.}^{-1} y - \sqrt{2ry - y^2}$, we have

$$\frac{d\ x}{d\ y} = \frac{y}{\sqrt{2ry - y^2}} = \frac{y}{x},$$

and $x^2 + y^2 = 2ry$ is the equation of the circular line of action.

To get the equation of the odontoid when that of the line of action is given, arrange the equation of the line of action in the form $\frac{y}{x} = f(y)$, put it equal to $\frac{d\ x}{d\ y}$, and integrate. Thus, the equation of the straight line of action being

$$y = \frac{x}{\text{tan. } A},$$

we have

$$\frac{y}{x} = \frac{1}{\text{tan. } A} = \frac{d\ x}{d\ y},$$

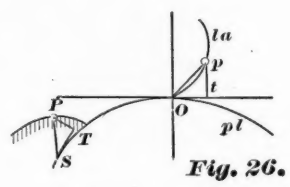


Fig. 26.

and $y = x$ tan. A is the equation of the straight odontoid at right angles to the line of action. Again, the equation of the circular line of action being $x^2 + y^2 = 2ry$, we have

$$\frac{y}{x} = \frac{y}{\sqrt{2ry - y^2}} = \frac{d\ x}{d\ y},$$

and $x = \text{ver. sin.}^{-1} y - \sqrt{2ry - y^2}$ is the cycloidal odontoid.

34.—THE ODONTOIDAL INTEGRATOR.

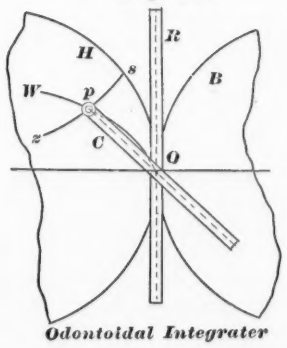
The form of the odontoid to correspond to a given line of action and a given pitch line can be determined only by the integral calculus (33), it evidently being impossible to contrive a general graphical or algebraic method.

But it can be directly drawn by an instrument, the principle of which is analogous to that of the well-known polar planimeter for integrating surfaces.

The bar R, Fig. 27, moves at right angles to the line of centers, and it moves the pitch wheel A, with the same speed at the pitch line. The bar C has a point p, that is confined to move in the given line of action $O\ p\ W$, and it is so guided that it always passes through the pitch point O.

The two bars bear upon each other by friction, and we must suppose that there

Fig. 27.



Odontoidal Integrater

is no other friction to oppose the motion of the bar C.

Then the point p will trace out the odontoid $s\ p\ z$ upon the pitch wheel A, or upon any other pitch wheel B rolling with the bar R on either side of it.

The principle of this instrument is the law of the speed of the point of action along the line of action (19).

Mills and Mill Engineering.*

The works inside of the building, however, are the main substance of the mill, and require the principal care and thought.

When we come to consider these we find that modern mills, especially for some kinds of textile fabrics, have become very complicated, and the tendency in manufacturing generally is toward greater complexity. Sometimes a new improvement simplifies a machine or process, but more often it brings in some new organ, machine or apparatus to do the work better or to do something which was previously neglected or trusted to manual labor.

To get all the different works co-ordinated in the best way, free from mutual interferences and needless complexities, it is desirable that substantially everything should be planned before anything is built, though some small matters like details of gas-piping, wiring for electric lights, etc., may be left to take their chances; they must keep out of the way of other things in any case.

Some ingenuity and much patient study are needed on the part of the designer to get plans thus well matured in advance of construction. Time is also needed, and owners are often unable or unwilling to allow this. It requires less mental effort to take one step at a time and trust to luck for the succeeding ones—to put up shafting and belts, and then consider how to arrange the various systems of piping, etc. But in doing this, one will always find some of the previous constructions which he wishes were different and which might have been varied as well as not if the requirements of the later work had been seasonably brought out by planning all at the same time.

Of course the planning should begin at the right end: first, the determination of the product required, and the schedule of machines to make it; then the placing of these machines in convenient relations to each other, and so as to use floor space to advantage, leaving only so much as is needed for passage-ways, stock in process, etc.

Along with this must be considered the dimensions of building and number of stories required to furnish the needed floor space conveniently and without breaking departments; also, the nature of the power plant, the location of the rooms relative to to it, the spaces required for main belts, etc.

Other things being equal, it is desirable to have the water-wheels within the mill, so that the power may be carried from a first horizontal shaft of moderate length directly to the main shafts in the different rooms. The same principle applies in the case of steam engines; but when their fly-wheels are too large to go inside conveniently, they may be placed just outside and still have the advantage of belting directly to the principal main shafts.

It is obviously desirable to have the boilers in a one-story building at a moderate distance from the mill, and in any case to have ample space, say seven feet high above them for pipes, light, inspection and repairs.

It is well to have a large number of main shafts driven directly from the fly-wheel or main drum. This saves dividing up of power further on by other transmissions through large counter-belts, which are always objectionable over the machinery. Many small ones must be used, however, and it is important to locate them where they will do the least harm. It is a good rule never to run pipes through them, with the risk of their being pulled down and broken by the belt in case of accident, allowing escape of steam, gas or water.

If sprinklers are to be used, their locations should be considered, and reasonable concessions should be made to keep the shafting and belts clear of them, and, as well as may be, of the pipes for supplying them. The same is true of steam pipes for heating and of atomizers for moistening the air and the pipes for supplying them, if these are required.

Formerly it was the general custom to heat by pipes running along the walls under the windows. This would seem to be the best position for taking care of the cold air coming down from the walls and windows. But pipes here take up about four inches of space, ordinarily one per cent. of the whole floor area. Inflammable stock, lint, waste, etc., are also likely to come in contact with them, increasing the risk of fire. These objections can be avoided, in part at least, by placing the pipes overhead, where, if they are near the walls, they heat the rooms well enough. Usually the top of a room is less crowded with shafts and belts near the walls than toward the middle.

Within the last few years the system of indirect heating with steam coils and blowers has been coming into use and has given good satisfaction.

Other things being equal, it is desirable to have a shaft run along the middle of the space which it serves with power, so that the counter-belts can balance each other in their pulls upon it.

All counter and machine belts less than about six inches wide should have room enough to run off or be thrown off, on one side at least, without fouling, and it is well to have positive stops to prevent their running off the dangerous side, if there is one. I have seen plans made for four or five machine belts to run in close proximity to each other on one wide pulley—a very unprofitable and dangerous thing to try.

A competent designer who knows that such arrangements are inadmissible will not get caught in them; but he will often find good reasons for going back and changing his previous drafts, moving shafts sidewise and also altering their make-up, in favor of other things. Sometimes the modifications will run back even to the arrangements of the machinery and of the building.

The most difficult cases arise in connection with alterations and enlargements of existing plants. In these cases, especially, it is often difficult to decide between several alternative schemes, all having some unsatisfactory features. If the designer is a conscientious and painstaking worker he will develop these schemes, and perhaps some others which are thought of during the process, far enough so that whoever is to decide between them can clearly see their respective merits and defects.

In planning transmissions of power, it is important to consider where the minimum of costs occurs, as between pulleys and belts. The larger the pulleys are the more they will cost, but the faster the belt will run and the less will be its width and cost, at first and also for renewal. It will also make less pull and friction on the shafts, develop less dirt and electricity, and can be more easily thrown on and off. Many manufacturers and mechanics never even think of these things, and would be greatly surprised to know how much money they have wasted and how much inconvenience they submit to in using wide belts at low speeds.

Due regard to these considerations will usually fix the diameters of counter-pulleys at 30 inches and upward. With such diameters the advantages of using double-thick belting ordinarily exceed the disadvantages, and this halves the widths, saving space, which is often important, and looking neater, in any case.

It is desirable that all the piping, shafting, pulleys and belts, and especially these running parts, should not only barely clear their surroundings, but should have ample space around them, for convenience of erection, care, repairs, etc. Failure in this respect is fatal to anything like elegance of design.

If everything is well arranged the mill will look much simpler and the designer will receive less credit than if he had thrown it together at haphazard with more shafts and counter-belts, more complicated piping and more crowding generally.

* We published an extract from this paper in our issue of April 17; this is the concluding portion.

Much the most common practice in designing shafting is to depend for its support wholly upon hangers on the floor beams or columns, usually 8 feet apart or more; then the best that can be done is to locate the larger pulleys for main and counter-belts close to a hanger on one side, hence 5 or 6 feet from the one on the other side. This throws too much of the strain on to the near hanger, and moreover the head length of shaft, which carries the main pulley, has to be made much larger than is needful for any other reason, merely to avoid excessive bending. Very often the same is true to a greater or less extent of the rest of the shaft. Very often, also, the increase of size to secure stiffness is insufficient, so that too much bending occurs and wastes much power without attracting attention.

Some 20 years ago certain wide-awake manufacturers made a new departure in the direction of using very small shafts at high speeds. This was pushed to an extreme, which required many intermediate hangers—perhaps one in every bay, on an average—and was troublesome in other respects.

As to the main pulleys, it is much better, and little if any more costly, to locate them wherever they are wanted—anywhere in any bay—then put in special timbers so as to have a hanger close to the pulley on each side and each equally well supported.

As to the rest of the shaft, the best modern practice steers between the two above-mentioned extremes; fixing minimum diameters by the rule that a shaft must be stiff enough to carry the great majority of its pulleys and belts without intermediate hangers, and then putting in the latter wherever they are needed to take good care of all the wider ones, and of assemblages of narrow ones in any one bay.

In comparing such a system with one requiring intermediate hangers throughout, we shall find no important difference in cost or in power required, but the former will be simpler, more elegant and more convenient. It will be better than a system having no intermediate hangers in every respect.

Special timbers for carrying hangers and other things which ought to remain strictly in place, are often injudiciously made to depend upon clamp connections only; *i. e.*, they are merely bolted flat against their supports, so that shrinkage, jarring, belt pull, etc, are sure to result in displacement. This should always be prevented by shoulders or positive stops of some kind.

The speeds of shafts are limited mainly by these considerations:

a. It is desirable to have them fast enough to transmit all the power required with the smallest practicable diameters. Also to have the pulleys which drive the machines as small as may be without having any of them too small; *i. e.*, to get the proper belt speeds with small, quick-running pulleys, which are cheaper and less in the way than larger ones.

b. The speed is limited in the other direction, not only by the condition that none of the pulleys shall be too small, but also by the fact that it is unwise to incur unnecessary friction, etc., by running faster than needful; also by the obvious inconveniences and dangers of running ordinary shafting and pulleys faster than about 500 revolutions per minute.

Much has been said lately, with some show of probability, as to the impending transfer of a large share of our New England manufacturing business, and especially in the heavier and coarser lines, to the South and West. Whether this movement is to be more or less rapid and general, it seems that our best policy here is to turn an increasingly large part of our attention to the production of fine and high priced goods, the business of making which cannot be so easily learned and started by beginners elsewhere.

The principal requisites for this are capital, of which we have plenty; energy, in which we are not deficient; and skill, which is most important of all. We have considerable of this already developed, and perhaps an unrivaled capacity for acquiring more by trying.

This skill is needed not only at the head, but down through the ranks of the operatives. Bad conditions do not develop, attract nor hold good operatives; instead of this they give a procession of indifferent ones; sometimes there are not enough of them to keep all the machinery going, and at other times the pay-rolls are loaded with too many spare ones, in anticipation of such a scarcity.

Some of the good conditions which are profitable to have everywhere, and are especially needful in making fine and high-priced products, are as follows:

1. Good light, temperature and ventilation. In many places some or all of these desiderata are lost or thrown away with scarcely any saving of cost or other advantage, without thought or question.

2. The different departments should be well balanced, so that none may be over-strong and costly for the amount of work required from it.

3. Every shaft should make its appointed number of revolutions, with clock-like regularity, through every second of running time.

All these things depend largely upon the design and construction of the mill, partly also upon the management.

4. The overseers and sub-overseers must do their work well and promptly, so that no machine will wait for attention longer than is positively unavoidable.

5. To make sure that these possibilities are made actualities, that no machines shall wait unnecessarily for power, material or overseer's attention, a live manager is usually needed. In many cases he will find it essential to have a good and minute system of accounts and reports, so that he may keep watch not only of his total weekly products, but also of the details by machines.

6. If these things are well attended to, the principal condition for keeping good operatives will be fulfilled; viz., they will have opportunity and incentive to do full work, and will be able to make good products in large quantities; hence to earn good pay at moderate rates per pound.

This brings us to the end of our story. These are the results for which mills are built; the making of good products in large quantities at moderate cost is the prime condition of success.

An electric railway in Siam has been incorporated, and will be built at once from Bangkok to Paknam, a distance of thirty miles. This road is to cost $400,000, and Siamese capital will alone be used. An electric light company has also been organized, and the plant ordered for Bangkok.

A former member of the University of Illinois was suspended in 1885, six weeks before commencement, when it is presumed he would have graduated. He has now begun suit to recover what he considers his rights.

Work Sheet.

Methods of keeping systematic and accurate accounts of the cost of finished products are receiving a constantly increasing share of attention in our American shops and manufactories, and it is getting to be generally understood that the accounts, in order to be of the greatest practical value, must be so arranged as to show not only the total cost, but the cost of each item entering into the final cost, so far as practicable. We give on this page a reproduction, on a somewhat reduced scale, of the head of a blank form which constitutes part of the system of the Simonds Rolling Machine Co., for keeping these accounts.

The heading and sub-headings explain the uses of the blank fully. The machines in use in the works are all numbered, and the number of a machine is entered in the first or No. 1 column. In the second column is entered the name or other designation of the work that machine has been employed upon during the week, as many horizontal columns being used as there have been different jobs on the given machine during the week.

A sample entry for machine No. 1, making carriage axles, is given, to show the method, this being, of course, an imaginary case. A study of this blank will show that it possesses many good points, and shows at a glance just what has been done during any week by each machine, and in such a manner that comparisons between different weeks and between different machines may very readily be made, as well as comparisons of waste, etc. A set of such blanks carefully filled out and kept on hand will prove of great value in many ways for all most any kind of manufacturing operations.

SIMONDS ROLLING-MACHINE COMPANY.

Work of Rolling-Machines for Week Ending May 12, *1892.*

MACHINE.		Running Time.		Nos. of Pieces Made			Pounds of Stock.					Per cent. of Waste to Product	Weight per Piece lbs.	Number per Pound.	Cost of Stock put into Product.		Est. Selling Prices.		Labor Cost of Rolling.	Losses on Waste.	Total Cost of Stock. (Add Cols. 17 and 21.)	Total Cost of Stock and Labor. (Add Cols. 20 and 22.)	Values in Col. 19 exceed those in 23.	
No.	Making.	Days	H'rs	Rejected	Accepted.	Per Hour.	Delivered.	Rejected.	Used.	Waste.	Put into product.				Per lb.	Totals.	Rates	Totals.					Difference.	Ratio.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	*Carriage Axle No.* 19.. ..	6	59	11	2423	41.25	53,548		53,548	2726	50,822	5.36	20.88		2.35	1194.32	.72	1744.56	17.70	44.98	1239.30	1257.00	487.56	1.39

Cyclones.

By Edward W. Furrell.

The Louisville cyclone, which has plunged so many families into mourning, was undoubtedly a most formidable visitation and startling evidence of the destructive power of nature's forces and man's insignificance.

The increasing frequency of these extraordinary atmospheric disturbances, the suddenness of their approach, and the uncertainty of their location, engender lively apprehension, and appeal to science to devise means for averting their death-dealing effects.

An examination of the ruined district has revealed the fact that several buildings (the Fort Nelson in particular) withstood the greatest violence of the wind, and that these buildings are of solid and substantial construction.

The art of building, though *theoretically* developed to a high degree of complexity and perfection, is *practically* deficient in *stability* and subservience to the safety of life. It is a big subject, and, in view of the heart-rending calamity referred to, a few queries and suggestions will not be irrelevant, and may be useful.

In constructing a building it seems to me that the element of safety from atmospheric pressure should be the first and enforced consideration, and its utilitarian design subordinated. Walls of brick or stone should be solid from foundation to roof, and of proper thickness throughout. The cement used should be the very best that can be produced, so that the component parts of a wall will adhere tenaciously together, and thereby form an elastic, but stable surface. Inside walls should be made substantially in the same manner, and arranged to the best advantage for resisting the thrust of the outside walls, to which they should be intimately united.

Bonds of a suitable kind, such as hoop iron, tie bolts, etc., should tie the brick-work together in all directions. Floor joists should be built into the walls in such a manner as to constitute ties to the outside walls for resisting the tendency of the latter to collapse outwardly from internal pressure, as occurs in cyclones, the whole forming a compact, interdependent structure, so that, when one part was subjected to extreme pressure, the strain would be distributed through the other parts, and resisted to the best mechanical advantage by the entire building.

It is presumed that the above essentials of good building are thoroughly understood by architects and others; but are they carried out in practice, except in the better class of buildings? Is it not notorious that, in many ordinary buildings, walls are made too thin, and the cement used of a cheap, inferior, inadhesive quality? Are not inside walls generally so thin and badly joined to the main walls as to be useless as an element of strength? Are long tie bonds between the brick courses used to any extent, or floor joists utilized as ties?

It behooves the public to be alive to these matters, and to see that the buildings which shelter their families are of the best possible material and construction for resisting extraordinary actions of wind.

In conclusion, I am of opinion that, without departure from ordinary types, and at a reasonable cost, buildings can be erected that will escape the most furious wind-storms ever known in this country.

Eighty-five Hours to America.

There is something practical in the scheme to reduce the passage across the Atlantic to about three days and a half, for which purpose a company has been formed. The aim of the promoters is to reduce the length of the Atlantic voyage to about 1,700 miles, as against the 3,052 miles between New York and Liverpool. This they propose to accomplish by constructing a railway along the north shore of the River and Gulf of St. Lawrence, from Quebec to St. Charles Bay, on the Labrador coast, a distance of 844 miles. With vessels steaming 20 knots, the promoters of this scheme calculate upon the sea voyage between St. Charles Bay and Milford Haven, a distance of 1,700 miles, being made in 3 days, 13 hours, as against the average of 6 days, 8½ hours from New York to Liverpool. Quebec is over 500 miles nearer to Liverpool than New York, but there are no ocean greyhounds on the Canadian route, and so it happens that, with a much shorter course, the Dominion steamers not infrequently take two or three days more than those sailing to New York to make the crossing. The capital of the company is £4,000,000, and government assistance to the extent of £600,000 or £800,000 is expected from the federal authorities at Ottawa, apart from what may reasonably be looked for from the government of the province, which would derive material benefits from the construction of the road, through the opening and working of the numerous mines, guano deposits, and quarries of marble and other ornamental stone which exist in the district through which it is to run. The bill constituting the company has already passed the Dominion Parliament, and is now before the senate.—*Iron* (London.)

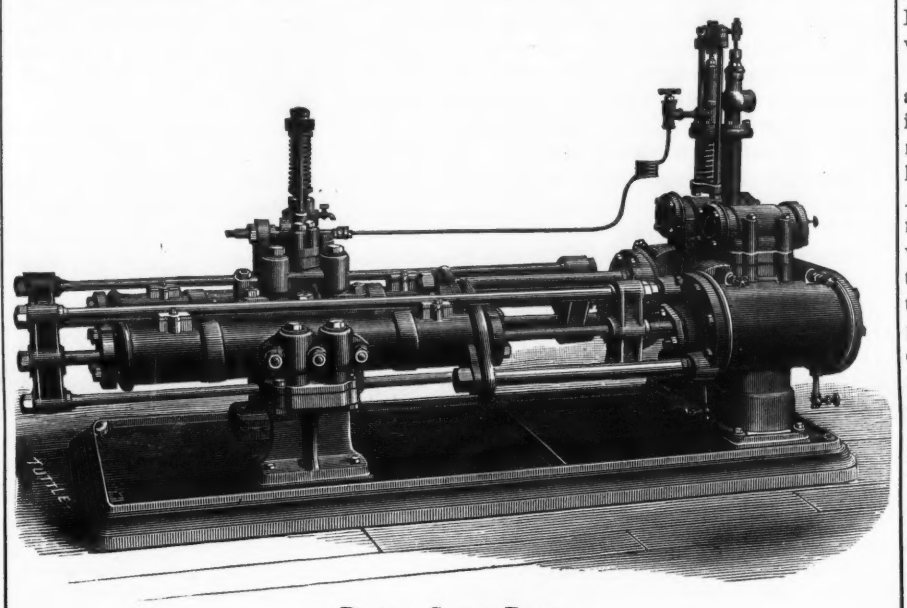
Duplex Pressure Pump.

With this we give an illustration of a duplex steam pump built for use in connection with cotton, linseed oil, lead and hydraulic presses, by the Hall Steam Pump Co., New York City. It is designed for pumping against pressures of 3,000 to 5,000 pounds per square inch, and pains have been taken to secure simplicity, durability under severe usage, and accessibility of parts.

The steam end of these pumps is of the standard "Hall" pattern, with steam-actuated valves, and the proportion between diameter of steam and water ends is fixed in accordance with the work to be done.

A governor is placed on top, which, when the pressure reaches the desired height, compresses the spiral spring shown, raises a valve and allows the water to pass through the small tube shown, to a piston which it moves, and thus regulates the supply of steam, and controls the movement of the pump and the pressure.

All parts of this pump are made to gauges and are interchangeable, so that renewal of parts worn out or broken is an easy matter. They are made in thirteen sizes, with steam cylinders from 5 to 18 inches diameter; pump plungers from $\frac{3}{4}$ to $2\frac{1}{2}$ inches diameter, and stroke 6 to 12 inches.



DUPLEX STEAM PUMP.

To Find the Proportions of the Steam Ports and a D Slide Valve.

To design an ordinary slide valve and to determine the size of steam ports for an ordinary steam engine is a simple matter; but, judging from the number of questions received, relating to this subject, we conclude that it is by no means clear to the every-day engineer. In this article we shall endeavor to present this subject in as simple a manner as possible, and we shall adopt a graphical treatment, when simplicity demands it, and shall take for an example the following question sent us by one of our correspondents. What should be the size of the steam ports, exhaust port, and common slide valve of the *D* form, for an ordinary steam engine diameter of cylinder, 5 inches; stroke, 5 inches; number of revolutions per minute, 1,000?

The first step will be to determine the size of ports; to do so, we need to know the piston speed in feet per minute. The engine makes 1,000 revolutions per minute, the stroke is 5 inches, hence the piston speed will be $\frac{5 \times 2 \times 1{,}000}{12} = 833.33$ feet per minute. It is customary to make the area of the steam ports equal to $\frac{1}{10}$ of the area of the piston for a piston speed of 600 feet per minute, and for higher speeds larger in proportion. Consequently for finding the area of the steam ports in the given example, we have the following proportion:

$$600 : 833.33 :: .1 : x$$

working out this proportion, we have,

$\frac{833.33 \times .1}{600} = .138$, which means that the area of the steam port should be equal to .138 times the area of the piston. The area of a 5 inch piston is 19.63 square inches, hence the area of the steam port should be $19.63 \times .138 = 2.70$ square inches. The length of the port is an arbitrary matter; it is generally made as long as the design of the engine will permit, so as to allow as great a quantity of steam as possible to flow into the cylinder at the beginning of the stroke. The general practice is to make the length of port equal to about three-quarters of, or equal to the diameter of the cylinder. Let us make the port 4 inches long; its width is then found by dividing the area—previously computed—by the length of the port, hence we have,

$\frac{2.70}{4} = .675$, say $\frac{11}{16}$ inch wide.

Here then we have found that for the given piston speed each steam port must be 4 inches long and $\frac{11}{16}$ of an inch wide.

Our next step will be to find the lap of the valve. The lap will depend on the point of cut-off; we shall assume that the steam is to be cut off at $\frac{3}{4}$ of the stroke. To find the lap to suit these conditions, we employ the following graphical method.

Describe any circle *A M B* (Fig. 1) whose diameter is larger than what the travel of the valve is expected to be; in this case we have drawn it 4 inches diameter. Through the center *c* draw the diameter *x y*. Now, since the steam is to be cut off at $\frac{3}{4}$ of the stroke, divide the diameter *x y* into 4 equal parts, and through the point of division marked 3, draw a line 3 *g* perpendicular to the diameter *x y*, cutting the circumference *A M B* in the point *g*. Join the points *y* and *g* by a straight line. Divide the line *y g* into two equal parts, and thus obtain the point *s*; through the point *s* draw a straight line *A B* perpendicular to *y g*, and join the points *y* and *B* by a straight line. From *s* lay off on the line *A B*, towards *B*, a distance which is equal to the width of the steam port, $\frac{11}{16}$ of an inch in this case, and thus obtain the point *b*. Through *b* draw a straight line *b* y_2 parallel to *B y*, cutting the line *g y* in the point y_2. Through the point y_2 draw a line y_2 x_2 parallel to *y x*, cutting the line *A B* in the point c_2. From c_2 as a center, and with a radius equal to c_2 *b* or c_2 y_2, describe a circle *a* y_2 *b*. Now, the distance c_2 *s* will be the required amount of lap; *s b* is the width of the steam port, the diameter *a b* is the travel of the valve, and if the connection between the valve and the eccentric is direct, that is to say, with no rockers, whose arms are of unequal lengths, interposed, the radius c_2 *a* will be the throw or eccentricity of the eccentric. We are now in a position to determine the width of the exhaust port. The general practice is to make the exhaust twice as wide as the steam port, and in the majority of cases this proportion is about correct. But there are cases in which such an exhaust port is wider than necessary, and sometimes it is not wide enough. It is therefore worth while to examine the matter. Fig. 2 represents the valve in the center of its travel; the dotted line *B* shows a portion of cavity of the valve when the valve is at the end of its travel. Here we notice that at the end of the travel a portion *f k* of the exhaust opening is covered by the valve, leaving a clear opening of the width *k g*. In order to obtain a free exhaust, the width *k g* of the opening should not be less than the width of the steam port. In order to obtain this amount of opening, we proceed as follows:

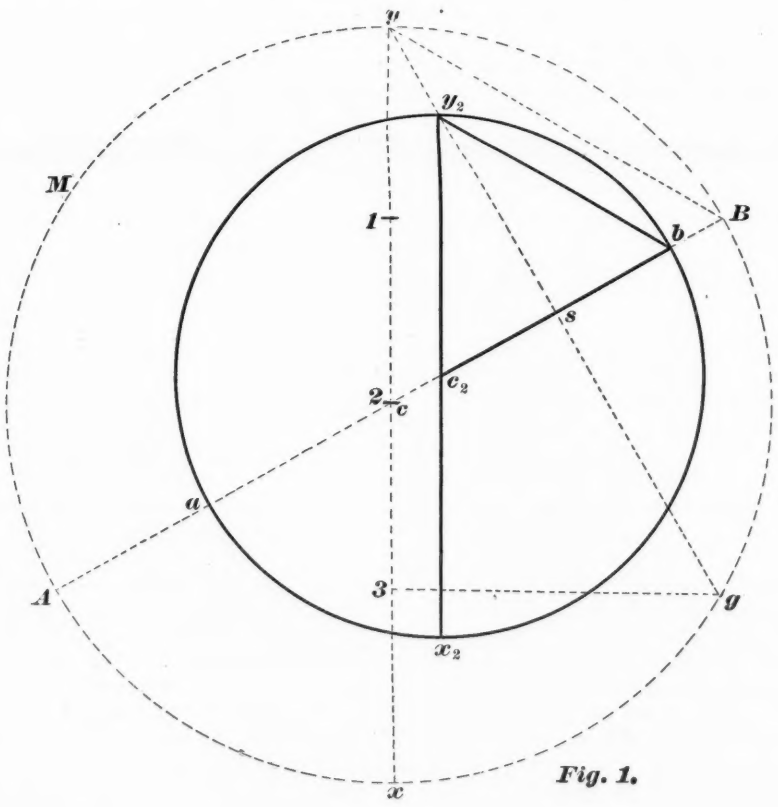


Fig. 1.

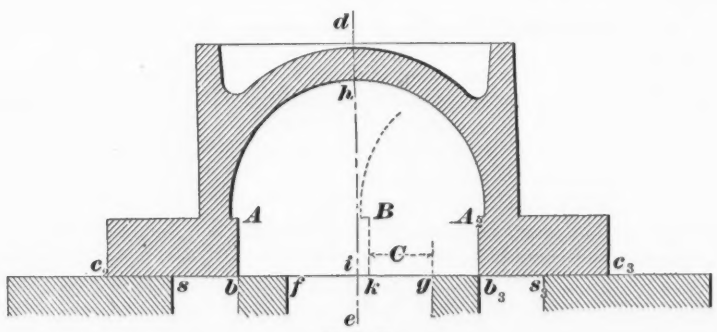


Fig. 2.

PROPORTIONS OF SLIDE VALVES.

Lay in the width of the steam port *s b*; also lay in the width *b f* of the bridge, which is generally made equal to about the thickness of the cylinder. If there is no inside lap, as we shall assume in this case, the edge *A* of the cavity will be in line with the inner edge *b* of the steam port when the valve stands in the center of its travel; hence to find the position of this inner edge when the valve is at the end of its travel, we simply make the distance from *A* to *B* equal to one-half of the travel, and thus obtain the point *k*; lastly make *k g* equal to the width of the steam port, then will *f g* be the width of the exhaust port. Bisect *f g* in the point *i*, and through this point draw the center line *e d* perpendicular to the face of the valve seat; and draw the bridge *g* b_3, and the steam port b_3 s_3.

We are now in a position to draw the whole section of the valve, as shown in Fig. 2. To do so we must first lay in the following dimensions, namely, the length of the valve c_2 c_3, the length *A* A_2 of the cavity, and the height *h i* of the cavity. The length c_2 c_3 is not yet known, but we do know the amount of outside lap, or simply "lap," as it is usually called, which we have found to be $\frac{11}{16}$ of an inch. Now, since the lap is the distance by which the valve extends beyond the outside edge of the steam port when the valve stands in the center of its travel, we have a ready way of finding the length of the valve, thus: Make the distance between the outer edge *s* of the port, and the outer edge c_2 of the valve, equal to the lap ($\frac{11}{16}$ inch); also make the distance s_3 c_3 equal to the lap; then the distance c_2 c_3 will be the length of the valve. This mode of procedure is equivalent to drawing the valve in the center of its travel, and, indeed, in designing a new valve of this kind it is always best to show the valve in the center of its travel, because in doing so we can determine the principal dimensions of the valve with the least liability of falling into an error. Under these conditions, the center line *e d* of the valve seat will also be the center line of the valve. The length *A* A_2 of the cavity will depend on the amount of inside lap; in this case we have assumed that there is to be no inside lap, consequently the inner edge *A* must be drawn in line with the inner edge *b* of the steam port; and for the same reason the inner edge A_2 must be drawn in line with the inner edge b_3 of the opposite steam port. If the valve is to have inside lap, then the inner edge *A* of the cavity must be drawn somewhat closer to the center line *e d*, making the distance from the inner edge *b* to the inner edge *A* of the cavity equal to the inside lap; of course in every case the distance from the center line *d e* to the edge A_2 must be made equal to that between the center line *e d* and the edge *A*.

The height *h i* of the cavity, as made by different builders, varies considerably; our practice is, whenever the design of the engine will permit, to make *h i* equal to four times the width *s b* of the steam port, because we believe that with such a height we can obtain a freer exhaust than with a shallower cavity. We have now established the principal dimensions of the section of the valve; for the thickness of metal, good judgment must be used; for a valve of this size, a thickness of $\frac{1}{4}$ of an inch around the cavity, and a thickness of $\frac{1}{4}$ above the valve face, will probably give good results. The form of the back of the valve is arbitrary, the form here given is for convenience of fastening the valve readily and firmly to the planer, when valve face is to be planed. For some designs of engines this form of the back of the valve will have to be modified.

It should be noted that the lap as determined in Fig. 1 is correct only when the travel of the valve is equal to that found in the same figure, and this travel is equal to twice the sum of the lap and the width of

the steam port, as will readily be seen; hence at the end of the travel, the edge c_2 of the valve will coincide with the edge b of the steam port, consequently the steam port will be opened fully, no more and no less. If it is desirable to make the edge c_2 travel beyond the edge b of the steam port, the travel of the valve must be increased; but if the travel of the valve is increased the lap must also be increased, otherwise steam will not be cut off at $\frac{3}{4}$ of the stroke. To find the proper amount of lap under these conditions, we must make $s\,b$, in Fig. 1, equal to the width of the steam port, plus the amount which the valve is to travel beyond the steam port, and then proceed as before. In a similar way, if the valve is not to open the steam port fully, the travel of the valve, and also the lap, must be decreased. Under these conditions we make $s\,b$, in Fig. 1, equal to the amount of opening of the steam port, and again proceed as before. It will be of great benefit to the reader to find the amount of lap to suit the different travels of the valve, and observe the influence which the travel of the valve has on the lap. It will also be useful to remember that, when the travel of the valve is equal to twice the sum of the lap and the width of the steam port, and steam is cut off at $\frac{3}{4}$ of the stroke, the lap will be equal to the width of the steam port; hence in the given example the lap was determined as soon as the width of steam port was found, and the construction in Fig. 1 is unnecessary. But when steam is to be cut off at any other part of the stroke we must employ the construction given in Fig. 1, remembering that in every case the distance from the point y to the point marked 3 must bear the same proportion to the diameter $y\,x$ as the distance from the beginning of the stroke to the point of cut-off bears to the length of the stroke. Thus, if steam is to cut off at $\frac{7}{8}$ of the stroke, then the distance from y to the point marked 3 must be equal to $\frac{7}{8}$ of the diameter $y\,x$, and then proceed as explained.

Force in the Steam Engine and Its Relation to Smooth Running.

BY PROFESSOR JOSEPH TORREY.

NINETEENTH PAPER.

It was said in the last paper that side crank engines presented a very different problem from the double disk center crank type, as to the amount of balance practicable. This does not mean that they need less balancing, except so far as is due to the fact, borne out by the writer's experience, that side crank engines usually run at lower speeds, relatively speaking. This of course would modify the question, but I certainly believe that the counterweight should be the greatest permissible one in every case, and by this I do not mean the greatest the builder *guesses* is "about right," but the greatest consistent with weight, foundation, construction and position. If the whole engine is made substantially self-contained by being put on a strong sub-base, and if this sub-base be set on a thoroughly well made foundation balance may be carried to as great an extent as a well-proportioned crank disk will allow. The fact is, however, that side crank engines are set up in very many cases, perhaps in the majority of cases, without any sub-base at all. In this case the main bearing is on the main foundation, and the out-board bearing on a separate pier, which is, by the way, apt to be poorly built, and of insufficient area—especially when, as is often the case, additional pulleys are put on to enable more dynamos or machines to be run from the same engine. In a case of this kind, and with all these contingencies in mind, it is undoubtedly a serious matter to decide what degree of counterbalance is advisable. Whatever suggestions I make on this point are given with much diffidence, and can be taken simply for what they are worth, as my experience will not compare with that of many of my readers.

In the first place, then, notwithstanding all the possibilities of the case, I believe it is better to crowd the balancing as far as possible, even in this case; and how far is that? Just here is where the important question of "dead weight" comes in; that is, the weight of the motionless part of the engine. It is not best to have the counterweight such that, if unrestrained, it would lift the whole engine bodily, although with a properly constructed foundation the danger from this source is reduced to a minimum. Now there are two ways to obviate this difficulty: first, by cutting down the counterweight, and second by putting more metal in the bed.

This aspect of the case was considered through the columns of the AMERICAN MACHINIST by Mr. M. A. Beck. He certainly did what is very unusual in discussions on counterweight—arrived at some very definite conclusions. Those who may wish to read his original papers will find them in the AMERICAN MACHINIST for April 18 and May 16, 1885. I will here give simply an abstract of his results.

Let W = counterweight needed at radius of crank, over and above that required to balance crank and pin.

m = weight of reciprocating parts.

M = non-moving mass (cylinder bed plate, etc.)

F = mean of inertia forces at front and back end.

Then the proper relation between these elements is given by the formula,

$$W = \frac{F\ m}{M}.$$

This simple formula may be conveniently expressed in form of a rule, as follows:

Divide the mean of the inertia forces at front and back end, by the weight of cylinder and bed plate. Multiply the number obtained by the weight of the reciprocating parts, and the product will be the weight of counterbalance needed at the radius of the crank.

This must of course be modified according to the methods given in the seventeenth paper. From this formula a table has been calculated, which is here given:

$F \div M =$	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½
$W = m \times$	1 00	.8000	.6666	.5714	.5000	.4444	.4000	.3636	.3333	.3077	.2857
$F \div M =$	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6	6¼
$W = m \times$	.2666	.2500	.2353	.2222	.2105	.2000	.1904	.1818	.1739	.1666	.1600

We will take later a particular case or two, and see how this table may be applied in designing counterweights.

It is interesting to notice that this formula may be so transposed as to give us still further information. It may be put in the following form,

$$M = \frac{F\ m}{W}.$$

Now, in case of center crank engines, as has been said, there is generally no serious objection to balancing to the full extent, and when this is done the counterweight required at the radius of the crank will equal the weight of the reciprocating parts. In other words, W will equal m. Now, if $W = m$, in our formula, then $\frac{m}{W} = 1$, and consequently,

$$M = F.$$

That is, the weight of cylinder and bed plate should equal the mean of the inertia forces at front and back ends, expressed in pounds, of course.

There is one other point, with respect to counterbalance, which is certainly worth consideration. It has been shown that the action of weight in the crosshead or piston of an engine, is slightly different from that of the same weight in the large end of connecting rod. Now suppose for a minute that all the weights of the reciprocating parts were concentrated at the crank-pin, and that the piston, crosshead and body of connecting rod, weighed nothing. Now, on speeding up our imaginary engine we should get endwise shaking, just as in the ordinary case, only, as previously shown, the actual distribution of force throughout the stroke will be slightly different.

Now, if a counterweight be applied, equal at the radius of the crank to the weight of reciprocating parts concentrated at the crank-pin, the result will be that the engine will be perfectly balanced in every direction, and there will be no shaking or tendency to shake. In this case, the reciprocating parts, with their counterweight, act substantially like so much balance wheel, and there is no inequality at all.

Of course these conditions cannot be secured in practice, but we can certainly approximate to them. By making the piston and rod, crosshead and body of connecting rod as light as is consistent with strength, and then putting what extra weight may be thought necessary for quiet running (say enough to bring up the inertia at back end to about $\frac{3}{4}$ the steam measure, at beginning of stroke), in the large end of connecting rod, it is possible to balance to the full extent with much less vertical disturbance than by the ordinary method, and by paying a just amount of attention to making the bed plate heavy enough, referring perhaps to Mr. Beck's formula, or else remembering that the centrifugal force of the counterweight ought not to be much greater than the bed plate weight, still better results will be obtained.

It is my opinion that this is the best solution of the balancing question for any class of engines whatever; for, whether side crank, or center crank, it will always be true that the more of the reciprocating weight is put in the large end of connecting rod, the less vertical disturbance will result from a full balance; several of the best single valve, high-speed automatics embody this feature, and I can see no good reason why it should not be much more generally employed.

One more point is worthy of consideration. Since the advantages of high rotative speeds have come to be either openly or tacitly acknowledged by engine designers, there has been an ever-increasing tendency on the part of the builders of so-called low-speed engines to crowd their rotative speeds up to the highest permissible point. The results have of course shown more or less gain in steam economy, but not always a corresponding gain in running qualities. In some cases the results have been decidedly bad. It is my opinion that a large number of long-stroke engines are to-day running faster than their design will safely permit. The bad results show themselves in loosening foundations and shafts out of line mostly. It certainly seems as if the reasonable point where the need of some balancing begins to show itself was at the point where the oscillation became noticeable, and I firmly believe the running of some slow-speed engines would be improved, and their durability increased, by a little judicious balancing. Unfortunately, however, it is not at all probable that they will be for some time. Patterns once gotten out, and a standard engine designed, it takes considerable to make a change.

LETTERS FROM PRACTICAL MEN.

Safe Working Pressure for Boiler Flues—Error in Formula.

Editor American Machinist:

Despite the numerous attempts to solve this problem, no engineer seems as yet disposed to place confidence in the formula devised by another.

Being interested in the boiler flue question, the reply to the query of F. X. F., Oakland, caught my attention, and I send herewith my own solution.

A taper tube 8 feet long, tapering from 14 to 30", and varying from $\frac{5}{16}$" to $\frac{3}{8}$" thick, was given.

A parallel 30" x $\frac{3}{8}$" tube would, by my own formula, be safe at 65 lbs. A parallel tube of 14" x $\frac{5}{16}$" would stand 93 lbs. Taking an arithmetic mean would give 79 lbs., or $(93 + 65) \div 2 = 79$. Taking, however, a mean of the diameters and thickness, and so calling the tube $\frac{30+14}{2} = 22$, and its thickness $(\frac{3}{8} + \frac{5}{16}) \div 2 = \frac{11}{32}$, the formula works out as 73 lbs., which is not much in excess of the answer given to the query, namely 63, and as my formula is for circular flues, I should deduct something from the 73, for want of circularity. The formula I use in working pressure $= \frac{48{,}000\ t^{2\cdot2}}{D\sqrt{L}}$ D being the diameter in inches, and L being the length in feet, between rings. When L is very short, as for example, in the corrugated furnace or Brown's ribbed plate furnaces, the formula may give results too high and beyond the safe resistance of the material to compression.

I have another formula in which the working pressure is $P = \frac{6150t^2}{\sqrt{L}\ D}$ which for a 30 x $\frac{3}{8}$ tube gives 56 lbs. only, and for the 14" x $\frac{5}{16}$" tube gives 57 lbs. In this formula the flue diameter comes in as a factor under the root, whilst in the first, the strength varies inversely as the diameter simply, and seems more correct than the second. Unwin in his formula places D in the denominator to its 1.16 power, which appears likely to be more correct than placing it under a root sign, but Unwin puts L only to its 0.9 power, and experiment seems clearly to point to the strength varying inversely as $\sqrt{L}$ or as $L^{0.5}$. Another formula by Clark for lengths over 9 feet involves d to its 1.75 power, and would give the 30 x $\frac{3}{8}$ tube 73 lbs. pressure.

Personally I would use my own No. 1 formula for circular flues with good flanged seams—for modern high-class work, in fact; and my second I should employ when dealing with lap-jointed tubes, for in these the smaller the tube the greater the departure from true circularity, and as seen in the result given, whilst in the first case the small tube was over 40 per cent. stronger, in the second it was not 2 per cent. stronger, for it would be nearly twice as far out of truth in regard to its diameter.

Though the strengths of usual sizes and sections are known by practice, there are few reliable experiments to go upon.

Whatever rule be taken, the result must always be checked so that the actual crushing stress be never exceeded. The limit even for a corrugated flue seems to be about 20,000 lbs. per square inch of plate section, and corrugation seems to enable the material to resist up to its limit of elasticity or thereabouts. To properly test tubes experimentally, they should be tested in a vertical position, in order to eliminate the effects of upward flotation, or at least this should be also tested for ascertaining the loss of strength if any, due to flotation. The usual marginal factors of 3 to 4 allowed in boiler strengths are more than sufficient to cover the discrepancies in the formula quoted, and other formulæ give the results not far different. The most important difference from Fairbairn's old formula seems to be in the adoption of $\sqrt{L}$ in the formula in place of L, and Fairbairn's formula for collapse, though not to be depended upon as a collapsing formula, may be converted into a formula for working pressure by dividing by a factor $\sqrt{\frac{300}{L}}$. This formula, so altered, is often used in England as a guide, and, as altered, is supposed to give a working pressure about a fourth the actual collapsing pressure.

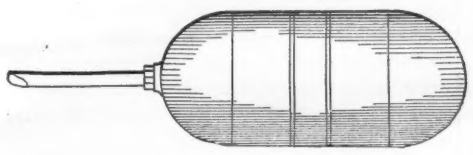
It would be well to make a few more experiments upon flue tubes, to ascertain the correct values to which t, L and D should appear in the formula.

These determinations would require three sets of tubes at least, in each set one of the above, these dimensions only being varied, so that the proper index could thus be ascertained for each quantity.

It is to be expected, also, especially as regards L, that the influence of this cannot be properly ascertained under usual conditions, for in a boiler the tube has a rigid attachment at one end at least, and the influence of this must be very great in the first foot or

two; for such rigid attachment must have great influence in stiffening the immediate front portion of the flue. It seems reasonable to suppose, then, that any true formula for short tubes would include $L-x$; x being the length influenced by the end plate attachment. To properly test a flue, it would be correct to test portions well removed from end support.

An absence of some weeks in Holland has prevented me from seeing and acknowledging earlier, the error in formula pointed out by Mr. G. L. Fowler in regard to air-pumps. The question of acceleration of falling bodies is one so infrequent with me that the enormous



discrepancy in the result did not appear evident to me. The error, which I must regret, will fortunately not alter in any way the principle which I was endeavoring to prove. It merely shows that from the horizontal air pump better work may be expected than I was prepared to claim, as the water will follow the bucket with a less head than I was assuming necessary. It is well to emphasize the fact that, whilst the water follows the bucket only under the influence of that portion which rises and falls vertically, it will not follow at the speed given by the formula $v = 32t$, but at a rate proportionally less in the ratio of the falling weight of water to the whole bulk moved. Thus, if 100 lbs. of water in the pump fall vertically, and attain a velocity of 5 feet per second in a half stroke of the bucket, then with a further 100 lbs. to be moved horizontally, the acceleration of speed can only be a half of that found by formula.

Since writing the article I have had some special experience with an engine having a horizontal air-pump and circulating pump combined, and having the stroke of the steam piston. The pump bucket had simply a short, straight middle length and two hemispherical ends, as per figure. The stroke was 27.2″, and the pump worked quietly up to about 90 revolutions per minute, at which speed there was a sharp clack occasionally, due to plunger making contact again with water. The condenser was entirely above, and the pump was 9″ diameter. The head of water could not be actually known. It was only about a foot from pump center to inlet valves above, but another two feet might be filled above the inlet valve, and so nothing definite could be measured. The pump, however, was quite satisfactory.

I am obliged for Mr. Fowler's correction.

W. H. BOOTH.

Interest in the Grindstone.

Editor American Machinist:

It is evident from the discussion of the shop grindstone that workmen generally find themselves working at a disadvantage where tools require much or particular grinding. I have worked in some forty shops, and in only one have I seen the grindstone business satisfactorily managed. It was in the machine shop of William Sellers & Co. The size and grit of stone, the speed, management of water, all were admirable.

If they would tell us how they select, mount, run and care for a shop grindstone, it might be of use to many. There must be general ignorance in this country as to what constitutes a good stone. I believe most of us have never seen one. Certainly all Ohio stones that I have seen, and most other American stones, are worthless. If a good stone could be got for three times the money it would be cheap.

In some Eastern shops, where rather small stones are used, I have seen them set up with a countershaft and pair of cones.

J. SMITH.

Grinding a Crank-pin.

Editor American Machinist:

Your articles on emery wheels, etc., bring to mind an experience with emery on a crank-pin.

The "engineer" had raised one end of the crank-shaft about an inch higher than the other, and because the pin run hot he came to the very brilliant conclusion that the builders of the engine had put it in "crooked," or out of line with the shaft.

Well, he could file that pin true; he could.

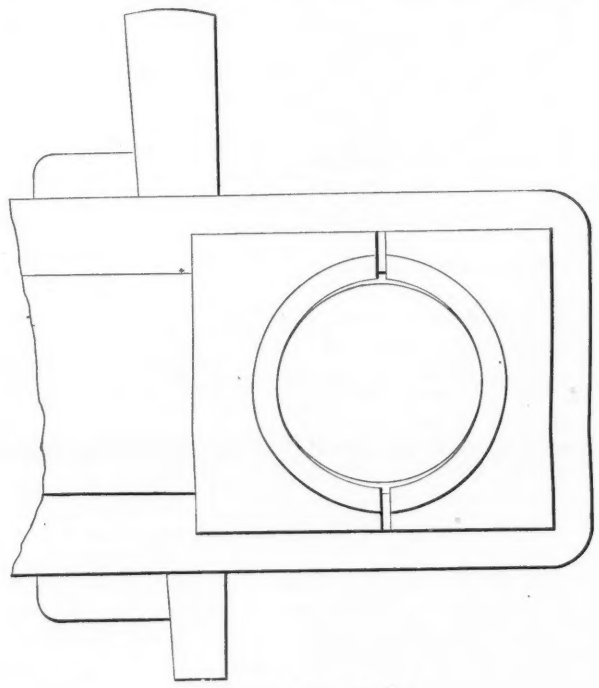
When he got through filing, the engine was "too small, anyhow," and he wanted it replaced by a Corliss.

About the first discovery we made upon our arrival was that the nearest machine shop was just 200 miles away. We sent back to the shop for a set of brasses, to be lined with babbitt and bored out $\frac{1}{8}$″ larger than tin—like sketch—this to remove a tendency of the crooked pin to twist the connecting rod.

After leveling up shaft and crosshead, we filled the crank-pin box with coarse emery and started up. The idea was that the emery would imbed itself in the babbitt, and all the cutting would be on the pin.

It took fourteen days—pulling the mill after the first day—to bring that pin down to a bearing; it was $\frac{1}{8}$″ smaller, but was round and true.

We found the babbitt had retained its shape, even the lathe tool marks being plainly visible, the surface appearing like emery paper.



GRINDING A CRANK-PIN.

A curious fact (to me) was that the pin did not heat, notwithstanding the fact that we used very little more oil than usual.

Now we have a wholesome respect for babbitt and "emery."

A MAN.

Bullying.

Editor American Machinist:

When I see an ignorant, unreasonable and bullying foreman or superintendent swaggering around among his men, abusing and insulting them, I am reminded of an experience of mine during my early boyhood, which made a lasting impression upon me, and I hope a good one.

Into the little town where I then lived there came one day a number of orphan boys sent "out West" from New York to find homes in a place where there was more room for them than in the crowded city. They found homes among the people of the village and were sent to school, child labor (at least in factories) not having been introduced there at that time. Among the boys was one named Allen, somewhat older and larger than myself, and possessed of the usual amount of boyish love of mischief and fun, combined with a knowledge of the ways of the world picked up in the streets and alleys of Gotham, which made him quite a lion among the boys born and bred in the little town.

One evening, as myself and "chum" were throwing a ball from one to the other in the street, Allen came along, and in a spirit of boyish mischief took the ball and threw it as far as possible down the street. I was enraged at this, and, running up to him, commenced, without thinking much of his superior age and size, to pound him with my fists. He made practically no resistance, whereupon my bravery and confidence in my prowess were much increased, as I attributed his non-defensive action to fear of me, which, considering his superior size, was, I thought, very creditable to me, and increased my importance a great deal. A man who was passing stopped the one-sided fight, and asked Allen why he let a little fellow like me pound him in that way. The boy answered that the people with whom he lived had forbade him fighting, and told him that if they heard of his doing so they would dismiss him, and let him shift for himself. A good many years have passed over my head since that time, but though I should live a great many more, I think I shall retain a very clear recollection of how mean and contemptible I felt, and how thoroughly I despised myself then. Instead of being great and brave, as I had supposed myself to be, I realized that I was a despicable coward and bully, and that the only reason I had not been licked out of my boots was because I could engage in fighting without danger of having my supply of bread and butter cut off, while the other boy lived with a couple who, having no children of their own, had forgotten how necessary it is for a boy to occasionally defend himself; and having no parental interest in the orphan boy, held the threat of banishment over his head should he exercise a boy's inherent and natural right to defend with his fists an attack upon himself. When I grew older and left the little town to pursue my ambition to be a machinist, I began to come into contact with men whom I thought should frequently despise themselves as thoroughly as I did upon the occasion of which I speak. They are the men who hold petty foremanships or other places which clothe them with a limited authority, and mercilessly abuse and wantonly insult men in every way their superiors, but so unfortunate as to be compelled to work, temporarily at least, under them. They are the foremen who never acknowledge the possibility of their having made a mistake, and who, when they do make one, and give a workman a wrong order by which work is spoiled, lie out of it, and abuse the workman for what they coolly charge him with being to blame for. They rave and curse at a man who has made a little mistake such as the best mechanic is sometimes liable to, thinking that because the man says little or nothing in defense of himself, he knows he is deserving of such treatment, the real reason being similar to the one which prevented Allen from defending himself.

A man with a wife and children at home depending upon him as their bread-winner, will sometimes take abuse and insults, which he knows he ought not to take, rather than risk the loss of employment; but the foreman who takes advantage of this to cover his own incompetency, or to vent his spleen, is a despicable coward and an unprofitable man for his employer besides. The best results are obtained from a shop where the men have the fullest respect for and confidence in their foreman, and this they cannot have if he shows them that he is a bully and a coward.

I am disposed to think that many a man "clothed with a little brief authority," who thinks he is doing great things by treating his men as though they were entitled to no respect whatever, is really causing others to secretly despise him as thoroughly as I despised myself until I had made full amends to the boy Allen.

T. A. PANDIE.

Naval Construction in Britain.

Mr. White is the chief naval constructor of the British Admiralty, and he has recently put forth his views in regard to different types of war vessels. He strongly favors large ships as being, on the whole, much more effective, especially in rough weather, than small ones. He says:

"The point here raised is not the absolute behavior at sea of ships of different sizes and weights, but their relative behavior under identical condition of wind and sea; consequently a judgment can only be formed by comparing the behavior of ships of different sizes navigating together. And the comparison is made most valuable when a fleet includes vessels of widely divergent dimensions with the gradations of size from the smallest to the largest represented, at fairly close intervals. Probably the maneuvers of 1889 fulfill these conditions better than any previous assemblage of ships. Beginning with the 'Inflexible,' of nearly 12,000 tons, by successive steps one can pass down to the torpedo gunboat of about 500 tons, and torpedo boats of less than 100 tons.

"While recognizing the comparatively limited scope of the operation possible during the maneuvers, it is undoubted that every one who saw these ships under circumstances of bad weather must have been impressed with the superior behavior and fighting qualities possessed by the largest vessels as compared with the smaller, when other features, such as freeboard and height of guns above water, were similar in the ships of differing sizes. But dealing simply with weight and length as elements influencing the behavior and the maintenance of speed at sea, it may unhesitatingly be asserted that increase in size has a most marked effect in improving sea-going qualities.

"No one doubts that ships of 3,000 tons, or even of much smaller displacement, may be perfectly safe and seaworthy in any weather, and may be capable of fighting in bad weather. The vessels of the 'Medea' class, for example, prove good sea boats and, as they carry two-thirds of their heavy armament on long poops and forecastles about twenty feet above water, it would be very bad weather to place them entirely *hors de combat*. At the same time, it was obvious when they were seen in rough weather alongside a cruiser of 5,600 tons or the 'Warspite,' of 8,400 tons, that these latter had very superior powers of maintaining speed and fighting because of their great size and weight. And if there had been present one of the new battle ships of 14,000 tons her advantages relative to the 'Warspite' had probably been no less marked.

"In speaking thus I do not desire to ignore the well-known fact that, under certain conditions of sea, larger and longer ships may pitch or roll more heavily than smaller ships. I am dealing, not with such exceptional circumstances, but with ordinary or average occurrences. At the same time, it may be interesting to add that during the maneuvers I repeatedly noted heavier pitching in the 'Warspite' and 'Black Prince' than was occurring simultaneously in vessels of the 'Medea' class. Occasionally heavy rolling of large ships has also been noted under conditions when smaller ships were comparatively steady. These exceptions will not, I think, shake the opinion of most naval officers that the largest ship is for sea work the best.

"'Fighting weather' is a very elastic term. Modern appliances have done much to extend its meaning. In the 'Howe,' when placed intentionally beam-on to a heavy sea, and with the ship rolling through arcs of 35° to 40° every five and a quarter seconds, the after turntable carrying two sixty-seven-ton barbette guns was cast loose, and the guns were successfully worked. It is doubtful if a smaller ship would have been as well placed under the circumstances.

A plate of glass measuring 145 by 195inches, and weighing 2,000 pounds, was recently made by the Kokomo (Ind.) Glass Works.

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J. G. A. Meyer, } Associates.
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Outgrowing Sixteen Pages.

Responding to the growth of the machinery interests of the country, the American Machinist will hereafter consist of twenty pages, the intention being to divide the four pages thus added, between our readers and advertisers. This step has been called for, both by the expressed preference of readers, and by the demands of advertisers desirous of gaining admission to our advertising columns, without the annoying and protracted delays that have, for more than a year past, been the rule in every instance.

This enlargement will enable us to make the paper more fully representative as to all its departments, and in view of the increased number of pages allotted to reading matter, it is believed no one will question the fairness of the small increase involved in making the subscription price hereafter three dollars a year, and the news-stand price six cents a copy, being the same rates as were for many years charged by us for sixteen pages.

We need not repeat that it is our intention for the future to adhere, in all respects, to the general line of policy which has proven so successful in the past, only improving upon it from year to year, as experience shows to be practicable.

The Swinerton Locomotive.

When the "Swinerton" locomotive first began to attract attention, we referred to the claims made for it, and treated them as absurdities. We did not suppose at that time that the Swinerton polygonal driving wheel tire would be heard of after a month or two, but some power has kept it alive until now, and we referred a few months ago to the fact that the tires were soon to be tried in such a way as to show their real value.

Since that time a set of the tires, having the flat spots milled upon them, have been tried upon an engine of the elevated road in this city, and the results have proved just as would have been expected by any one who should base an opinion upon the well-settled laws of mechanics and of friction. The idea has no practicable value whatever. The engine would do no more work than with smooth tires, unless noise be called work, of which she made plenty until the wheels were worn smooth by the persistent slipping, after which the engine did about as well as the others of her class, but certainly no better.

In the meantime the "Onward," which is the original "Swinerton" locomotive, is making occasional runs on the Central Railroad of New Jersey, but has certainly shown no points of superiority over the regular engines of the road. This engine, besides the polygonal tires, differs from standard engines in having only a single pair of drivers, an air cylinder, and system of levers by which extra weight can be thrown onto the drivers, and a sand blast apparatus, which the engineer in charge of her says was put on simply at the solicitation of its makers, in order to advertise it, but which is used with a persistency and regularity that lead one to infer that it is a necessity, nevertheless.

An inspection of the traction increasing apparatus would lead an experienced observer to infer that much more weight could be thrown onto the drivers than it is claimed is thrown on them. Altogether we must conclude that practical tests only bear us out in our original opinion regarding the value of polygonal wheels.

Electric Lighting.

There is trouble in New York—doubtless elsewhere—regarding the price demanded for furnishing electric lights for the city. The price charged for the coming year is, we believe, some thirty per cent. greater than that charged last year, and there is strong talk of going back to gas. The electric companies appear to have been unwise in dividing up the districts in such a way that there was no opposition to the bids of one or the other of the companies in these districts. Still we fail to see evidences of dishonesty in the action of the electric companies. If these companies had determined to fleece the city, it would have been more in accordance with the practice of adroit rogues to have taken pains to organize bogus competition. It would have been just as easily carried out as the scheme of having no opposition, and would not have been seen through so easily. We repeat, there is not as yet evidence of an organized attempt to cheat the city.

There has been a great and entirely natural desire on the part of electric companies to introduce electric lighting in all the cities of the country. And in order to gain a foothold the price for lights has in many instances been placed too low for the companies to make a reasonable profit on the original outlay. The hope has evidently been that, when the quality of the light was seen to be so much superior to the light from gas, the price could be raised without serious difficulty. But this is much easier said than done, as the electric companies are fast finding out.

Undoubtedly it would have been better if the electric companies had, in all cases, charged consumers — corporate and individual—a fair living price for light. Then, as fast as business was established, it would have been upon a substantial basis. But the greed of getting established operated to induce companies to sacrifice present gain, in hopes of future emolument. Electric lighting is hardly firmly enough established for an advance of price of thirty per cent., although that may be none too much.

The gas companies have a way of doing this, that works very well—for them. A new company starts in business, and puts the price of gas down about thirty per cent. wherever their mains are laid.

New consumers come into the fold, and all works smoothly for a few months. Then there is a consolidation, and the consumers of gas are taxed for building the new plant. Kerosene may stand in the way for a short time, but the fight is an unequal one, and in the end gas wins. For street lighting, electricity is about as much superior to gas as gas is superior to kerosene, and unless the charges for electric lights can clearly be shown to be extortionate, it will win.

There is one way out of the difficulty; that is, let the city furnish its own electric lights. But before resorting to this, it should be pretty clearly shown that the charges of the electric companies are extortionate.

The Elevated Roads and the Courts.

It has recently been decided by the Court of Appeals at Albany that, in fixing the damages to property caused by the erection of the elevated railroad structure in New York, juries may take into account any increase of value which may be shown to have arisen from the same cause.

Previous decisions of the courts had been that only the damaging effects of the roads could be taken into account, no matter if these damaging effects were nearly or quite overbalanced by the benefits. This later decision will, we think, be generally regarded as more in accordance with justice and common sense.

It always seemed rather absurd that a business growing out of the advance in engineering science, and directly in the line of human progress, should be burdened with charges for all the damages which might result from it, and then have its benefits thrown out of consideration. And yet there is a point in connection with the matter which seems to be worthy of some attention, and that is that, while all realty in New York City has been increased in value very much by the elevated roads, only that property which is on the street through which the roads run has been damaged by them. It would therefore seem that, to make things entirely fair all round, the owners of property which has been benefited and in no way damaged should pay for the benefits. They would then be on the same footing with those who have been benefited in one way but injured in another, the benefit offsetting the damage. In other words, it seems as though, if one set of property owners have the right to make money by the building of the roads, others have the same right.

But, while we think that this decision in favor of the company is a just one, we can but think that a just decision will go against it in a matter which is likely soon to come before the courts, relating to taxes due the city from a portion of the roads, the original charter for which required the road to pay to the city five per cent. of its net income as a consideration for the use of the streets and a valuble franchise. This portion of the roads has been leased to the Manhattan Railroad Company for a comparatively small rental, and it is claimed that five per cent. of this rental is all that is due the city. This, of course, is absurd if nothing worse, and it is to be hoped that the city will secure what was evidently intended it should secure according to the terms of the original charter, *i. e.*, five per cent. of the net earnings of the road, no matter whether the original company gets all of these net earnings or only a portion of them. The opinion is fast gaining ground that, where corporations use the streets of a city for operations by which they make money, some portion of that money should go to the people whose streets are appropriated.

Literary Notes.

LOCOMOTIVE ENGINE RUNNING AND MANAGEMENT: A Treatise on Locomotive Engines, showing how to Manage Locomotives in Running different kinds of Trains with Economy and Dispatch; giving plain descriptions of Valve Gear, Injectors, Brakes and other Locomotive Attachments; treating on the Economical Use of Fuel and Steam, and presenting Valuable Directions About the Care, Management and Repairs of Locomotives and their Connections. By Angus Sinclair, Secretary American Railway Master Mechanics' Association, Member American Society of Mechanical Engineers, &c. Fourteenth Edition, carefully revised and enlarged. New York: John Wiley & Sons, 53 East Tenth Street. Price $2.00.

The fact that this book has passed to the fourteenth edition within five years is sufficient evidence of its popularity; for in doing this it has run the gauntlet of the most critical of all judges—that is, the men whose every-day work it is to do just what is described in its pages.

The author, who is well known as one of the very foremost writers on railroad mechanical matters, was formerly a locomotive engine runner, and later in charge of locomotive repairs. In these positions it is evident that his industry, and habit of storing away knowledge practically gained, furnished the material of which this book is constructed.

All the detail is gone through with in a very thorough manner, and no space is wasted. But the author understands better than most men that dry detail often becomes uninteresting, and hence he has woven it together in such a manner that one can read it from beginning to end almost as he would read a story by Dickens, gathering the information he is seeking with the least possible mental effort. Or he can read a chapter at random with the assurance that he will find something both instructive and interesting. In these respects no book treating what are usually dry mechanical subjects excels it.

Although intended for engineers, firemen and railroad mechanics, Locomotive Engine Running and Management is a book that will be read with interest by every one who has the least inclination to gain an understanding of how trains are moved over railroads, and repairs on locomotives kept up.

There is nothing in it beyond the understanding of the ordinary reader, and yet it is most comprehensive in the treatment of the subject.

The fourteenth edition is not only considerably enlarged, but chapters and sections have been thrown out outright, and new matter substituted. The intention has evidently been to bring the new edition quite up to the times in all respects. The author has spent a good portion of the past five

years watching critically the operation of the principal railroads in the country, and in this way has gained information of the progress going on, which he has embodied in this edition. Altogether it is a book that should be read and studied by every engineer, fireman and railroad machinist, and should be in the library of every one who desires to get, in the easiest manner possible, a knowledge of the subject treated.

THE VENTILATION OF BUILDINGS. By Alfred R. Wolfe, M. E., Consulting Engineer, Member American Society Mechanical Engineers, &c. New York, 315 Potter Building.

The author has published what we believe to be a valuable little pamphlet on the subject of ventilation. Few, except those who have made a special study of the subject, know much if anything about it. They can all learn something from this book. The price is 25 cents.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(158) W.R., Cincinnati, Ill., asks: How much larger in diameter than that of the cylinder are the cast-iron rings for piston packing? *A.*—The cast-iron packing rings are generally cast in one continuous ring, and are turned large enough to allow for the amount of metal to be cut out for the joint, and when sprung together will be about $\frac{1}{16}$ to $\frac{1}{8}$ of an inch larger in diameter than the cylinder. After they have been sprung together, and the ends temporarily fastened to each other, the ring is turned to fit the cylinder easily. This only refers to rings whose ends overlap each other about $\frac{3}{4}$ of an inch.

(159) M. H., New York, asks: 1. Does a horizontal engine require more lead at one end than at the other? *A.*—For all practical purposes the lead should be the same at both ends. 2. Does the crosshead stop longer at one end than at the other? *A.*—No. Some engineers insist that the crosshead does not stop at the ends. 3. Where is the best point of cut-off? *A.*—The point of cut-off depends on the steam pressure, class and size of engine. For non-condensing engines the point of cut-off will vary from one-quarter to about one-half of the stroke, the former for high pressures and the latter for low pressures. 4. What is meant by one expansion, two expansions, etc.? *A.*—This is best explained by giving a definition of the term "ratio of expansion." Ratio of expansion is the proportion of the total volume of steam in the cylinder — the exhaust not being opened till the end of the stroke—bears to the volume at cut-off. If, for instance, steam is cut off at one-quarter of the stroke, then the volume which the steam will occupy at the end of the stroke will be four times the volume before cut-off; hence we say that the ratio of expansion is four. Looking at the matter in this light, we must consider the volume occupied by the steam before cut-off to be one expansion; and when the piston has traveled from the point cut off through a distance equal to the distance from the beginning of the stroke to the point of cut-off, the steam is said to have two expansions; and when the piston has traveled through another equal distance, the steam is said to have three expansions, and so on.

(160) C. P. R., Toronto, Canada, asks: Which of the following classes of locomotives will haul the most—a mogul or a ten-wheeled engine, and be the lightest on the road? *A.*—For the sake of comparison we will take engines having cylinders and driving wheels of the same size, and working with the same mean effective steam pressure. Say the cylinders are 19x24 inches; diameter of drivers, 54 inches; mean effective steam pressure, 90 pounds per square inch. Under these conditions the tractive power of each engine will be about 14,400 pounds, and the total weight on the drivers about 73,000 pounds in both engines. Consequently one engine will pull as much as the other, including the weight of the gines. But a ten-wheeled engine will weigh more than a mogul engine; a ten-wheeled engine of the assumed size will have about 23,000 pounds on the truck, making the total weight of this engine 96,000 pounds. The mogul engine will have about 14,000 pounds on the truck, making the total weight of this engine about 87,000 pounds. Now, since the mogul engine has less of its own weight to haul, it can pull a heavier train than the ten-wheeler, and, although the difference is small, it is in favor of the mogul, and, since the weight of the mogul is less than that of the ten-wheeler, we conclude that the mogul engine will be lighter on the road in hauling a given train than the ten-wheeler. But this conclusion in nowise condemns the ten-wheeled engine; this engine can, on account of its four-wheeled truck, haul a train with greater safety at high speeds than a mogul, and therefore the ten-wheeled engine is better adapted for a mixed traffic than a mogul; the latter is best adapted for freight service.

(161) Subscriber, N. Y., asks: 1. What will be the deflection of a steel shaft 5 inches diameter and 25 feet long, due to its own weight?—the shaft is simply supported at its ends. Please give rules. *A.*—In this case we consider the weight of the shaft to be the load uniformly distributed. Under these conditions the following formula is applicable:

$$\frac{5}{384} \times \frac{W l^3}{I E} = d \qquad (1).$$

In which W denotes the load or weight of the shaft, which we shall assume to be 1,700 pounds; I is the moment of inertia, which, for a circular section, is found by multiplying .7854 by the fourth power of the radius; the product will be the moment of inertia; hence in our example the moment of inertia will be

$$.7854 \times (2.5)^4 = 30.67 = I.$$

E denotes the modulus of elasticity, which, for steel, is 30,000,000; l is the length in inches of the shaft, consequently $l^3 = 300 \times 300 \times 300 = 27{,}000{,}000$; d represents the deflection in inches. Now substituting for the letters their values, we have

$$\frac{5}{384} \times \frac{1{,}700 \times 27{,}000{,}000}{30.67 \times 30{,}000{,}000} = d = \frac{5}{384} \times \frac{45{,}900{,}000{,}000}{920{,}100{,}000} = \frac{5 \times 49.88}{384} = .64 \text{ of an}$$

inch deflection. 2. What will be the deflection of the same bar when fixed at the ends? *A.*—For a shaft fixed at the ends, and the load uniformly distributed, the deflection is found by the following formula:

$$\frac{1}{384} \times \frac{W l^3}{I E} = d \qquad (2).$$

In this formula the letters have the same value as before. Comparing the two formulas we see at once that the deflection in the latter case is one-fifth of the former; that is to say, it is equal to $\frac{.64}{5} = .128$ of an inch. 3. What will be the deflection of the same shaft fixed at the ends with a load of 1,800 pounds in the middle? *A.*—The deflection is found by the following formula:

$$\frac{1}{192} \times \frac{W l^3}{I E} = d \qquad (3).$$

Here the letters have again the same value as before, with the exception of W, which is now 1,800 pounds. Substituting for the letters their values, we have

$$\frac{1}{192} \times \frac{1{,}800 \times 27{,}000{,}000}{30.67 \times 30{,}000{,}000} = d = .27 \text{ of}$$

an inch. This is the deflection due to the load alone; to this we must add the deflection due to the weight of the shaft found by formula (2); namely, .128 of an inch, giving us a total deflection of

$$.128 + .27 = .398 \text{ of an inch.}$$

We may sum up the whole matter by giving the following table of deflections for beams of uniform cross-sections:

UNIFORM CROSS-SECTION.	DEFLECTION.
Fixed at one end, loaded at the other	$\frac{1}{3} \times \frac{W l^3}{I E}$
Fixed at one end, loaded uniformly	$\frac{1}{8} \times \frac{W l^3}{I E}$
Supported at ends, load at middle	$\frac{1}{48} \times \frac{W l^3}{I E}$
Supported at ends, uniformly loaded	$\frac{5}{384} \times \frac{W l^3}{I E}$
Fixed at both ends, load at middle	$\frac{1}{192} \times \frac{W l^3}{I E}$
Fixed at both ends, uniformly loaded	$\frac{1}{384} \times \frac{W l^3}{I E}$

In all these formulas W denotes the weight or load, l, the length in inches; I, the moment of inertia; and E, the modulus of elasticity. These formulas are general, and may be used for beams of uniform cross-section; the cross-section may be round, square, rectangular, or of other forms. Of course the moment of inertia I will change with the form of section. We have seen that for circular section the moment of inertia is equal to the product of Rad.$^4 \times .7854$; for a square shaft it is equal to the fourth power of a side divided by 12. Rules for finding the moment of inertia for other forms of section are given in engineers' pocket-books and other engineering works. The modulus of elasticity E will depend on the material. The deflections found by these formulas will, of course, be only approximate, as the deflection will depend on the quality of the material. The formulas will only hold true within the limit of elasticity.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 16.

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Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

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Universal and plain Milling Machines. Pedrick & Ayer, Philadelphia, Pa.

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Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

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For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N.Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Horton's Chucks. We offer the balance of our stock at 50 per cent. discount. McFadden Co., Philadelphia, Pa.

Patents.—Patent soliciting of high class. D. Walter Brown, 31 Nassau st., New York. Send for "A Brief History of Patent Legislation in the United States."

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

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C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1882, 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per volume. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations. 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 5Jc. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Practical Drawing." By. J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellors of same patterm and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Construction Engineer. Estimates made on machinery and on damages.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES.

Doherty Brothers will build a foundry at Lowell, Mass.

The High Point Chair Co. will build a factory at High Point, N. C.

The Oregon City (Ore.) Woolen Mills will build an additional mill.

The Sparta Brick Company, Sparta, Ga., will build a planing mill.

S. C. Gittings is interested in a furniture factory to be built at Brenham, Texas.

The Crown Paper Co., San Francisco, Cal., is rebuilding its paper mills at Oregon City, Ore.

Ludlow & Kinsley, Windsor, Mich., lately purchased a site on which they will erect a planing mill.

The plant of the Bristol (Tenn.) Foundry and Machine Works will be enlarged and put in operation.

Fay & Scott, founders and machinists, Dexter, Maine, are about to build a 30x50 feet addition to their works.

The car and repair shops of the Missouri Pacific road at St. Louis, Mo., were recently partially destroyed by fire.

The Standard Oil Company will probably build a barrel factory in connection with new warehouses at Americus, Ga.

At Washington, La., a company has been organized to establish a cotton manufactory, with a capital stock of $75,000.

The immense plant of the United States Rolling Stock Car Company's works at Decatur, Ala., was recently destroyed by fire.

The Bristol Iron and Steel Company, Abraham S. Patterson, Philadelphia, president, will erect a blast furnace at Bristol, Tenn.

Pedrick & Ayer, Philadelphia, Pa., are increasing their shop facilities by adding two stories to their new shop and adding more tools.

The Brunswick (Ga.) Light and Water Co. expects to expend $50,000 in improving and enlarging its electric light plant, gas and water-works.

The President has approved the bill passed by Congress providing for the construction of a railway bridge across the White River at Arkansas Post, Ark.

The machine shops and roundhouse of the Northern Pacific at Ellensburg, Wash., were recently destroyed by fire. An engine and several freight cars were burned.

Walton, Wentworth & Hunter, composing the American Bridge and Iron Company, of Roanoke, will organize a $200,000 stock company to conduct the business of the same

The Board of Directors of the Kellog Seamless Tube Works recently held a meeting in Findlay, Ohio, and decided to begin operations at once at their factory, just north of that town.

The Mount Vernon Car Manufacturing Co. has been organized at Mount Vernon, Ill., for the purpose of building works for the manufacture of cars. Buildings will be erected at once.

The Orange (Fla.) Lake Manufacturing Co. has been incorporated by F. A. Gardner, D. H. Irvine, G. W. Wilson, and others, to erect a foundry and machine shop. The capital stock is $100,000.

W. L. Tillman and others, Columbus, Ga., have formed a company and bought the City Mills property and water-power. They will build a mill to grind 500 barrels of flour and 25,000 bushels of meal daily.

The Mount Tabor (Ore.) Water and Electric Light Co. will establish water-works and an electric light plant. The steam power plant will operate the pumps during the day and the dynamos at night.

The Farmers' Alliance Co-operative Manufacturing Company will build, at Iron Gate, Va., a foundry, 150x50 feet; a machine shop, 80x40; a wood-working shop, 40x40; and warehouse, 80x40; each two stories.

The Red River Bridge Company has been incorporated at Denison, Texas, by B. F. Colbert, J. B. Munson, W. B. Newman, and others, to build a bridge over the Red river at Denison. The capital stock is $40,000.

The Wytheville (Va.) Foundry and Machine Shops will be chartered, with a capital stock of $25,000, to erect foundry and machine shops. The present works of McWane & Co. will be moved to the new buildings.

Bottgher & Gessner, machinery repair works, Altona bei Hamburg, Germany, write us they are enlarging their machine shop, and intend to buy American machinery. They wish to obtain catalogues of iron-working machinery from American manufacturers.

Adam Brothers, of Jay [Maine], have invented and patented a water-wheel, which, it is claimed, embodies many new and improved features. The first wheel made for them has been set to carry the

works of G. L. Richards' mill at N. Fayette, which utilizes more than 80 per cent. of the whole power of the water directed upon it.—*Industrial Journal.*

A Springfield, Ill., dispatch says: "The Belleville Steel Company, at Belleville [Ill.], has been incorporated to manufacture steel products. Capital stock, $450,000. Incorporators, R. W. Waugh, W. W. Waugh and T. A. Meysenburg."

The Preston Hub and Spoke Factory Company, of Preston, Ga., has perfected its organization with a capital of $50,000, and the work of manufacturing will be at once entered upon. J. B. Hudson has been chosen president, and S. R. Stevens, secretary.

The Ohio Pulley and Machine Company have been organized at Warren, and will be incorporated as soon as possible, with a capital stock of $25,000. The company will manufacture split wood rim pulleys, and do a general machine business.

Frank Hornish, a machinist and patentee of note, is contemplating the establishment of a large engine and boiler works in Peoria, Ill. The plans for the buildings and plant complete will require a capital stock of somewhere from $500,000 to $1,000,000.

It is reported that an English syndicate has purchased all the leading sewer pipe works in the Ohio Valley, the investment amounting to nearly $2,000,000. The factories included in the deal represent a combined output of some 10,000 cars of pipe per annum.

The Texas Paper Mill Company have filed a charter for the manufacture of paper, in Dallas. They start on a capital stock of $50,000. The incorporators are: W. W. Lang and Judge John N. Wharton, of Dallas, and John Sutherland, of Aberdeen, Scotland.

The Steel Tubular Car Company, of Bradford, Pa., has bought 3,000 acres of land in Tuna Valley, between Bradford and the New York State line, and the erection of shops will be begun as soon as possible. The company will build fire-proof, indestructible, steel tubular cars.

The John T. Noye Manufacturing Company, Buffalo, N. Y., has closed a contract to furnish the city of Easton, Pa., with a complete steam plant of 400 horse-power for their electric light station, consisting of two Rice automatic engines of 200 horse-power each, and battery of boilers, a 400 horse-power Wainwright heater, shafting, pulleys, etc. It is proposed to make this an ideal plant.

The Tudor Iron Works, of East St Louis, have purchased the Waugh Nail and Steel Works at Belleville, Ill., and these will be consolidated with the Western Nail Works and the Valley Steel and Forge Company, which are now controlled by the Tudor Co., and form one big concern, with a large capital. When the arrangement is completed, it is said, the combined works will employ 3,000 men.

A company is formed with a large capital to establish a plant in New Bedford, Mass., for building iron and steel sailing and steamships. The proposed vessels are to be of large carrying capacity, fitted with all the modern improvements. They will be specially adapted to carry American products to all parts of the world at a low rate of freight. This company is ready to begin operations as soon as the Farquhar subsidy bill for American ships becomes a law.

The Springfield Emery Wheel Manufacturing Co. are removing to their new shops at Bridgeport, Conn., where they have erected buildings giving them 1¾ acres floor room. The shops are conveniently located, and the largest in the country devoted to such work. This company has taken up the manufacture of the Stratton & McCulloch car box grinder; also a car wheel grinder, the invention, we believe, of two men in the P. R. R. shops at Altoona. Business is excellent.

The works of the Simonds Rolling Machine Co. at Fitchburg, Mass., are to be enlarged as soon as possible, and considerable new machinery is to be put in. Twelve new rolling machines, larger than any heretofore built, are in course of construction, including one for making steel projectiles for the Government, 40,000 of these having been so far ordered. Other special machinery is being built for them by the Pratt & Whitney Co., besides which a number of standard machine tools and a new engine are to be put in.

The Cambridge Iron and Steel Company, of Cambridge, Ohio, have begun operations in the forge department. The machinery moved smoothly and work is going steadily on. The sheet mills will be ready for operation in about two weeks. The whole of this plant is modern. The engines are of Corliss type, made by the Brass Foundry and Machine Company, Fort Wayne, and the roll trains were built by the Lloyd Booth Company, Youngstown. $100,000 cash capital will be invested in the enterprise when completed, a few weeks hence.

In the Border City Mill No. 3, at Fall River, a radical departure in the construction of ring rails for spinning frames is being tried. It is patented by a local mechanic, and differs from the ordinary rail in that the rings are held in position by two grooved strips of wrought-iron or steel, and they can be adjusted independently and without the delay that is necessary under the present condition of things. Under the plan of the ordinary rail the holes for the rings and fastening screws are drilled. Mill agents are regarding the trial at the Border City with interest, as it is claimed that more yarn can be got on the bobbins, the new rail allowing a longer lift.—*Commercial Bulletin.*

The National Pipe Bending Company, of New Haven, Conn., manufacturers of the national feed-water heater, have recently issued a new catalogue, giving a list of users of that heater, which shows large numbers throughout the United States and Canada. They have also issued an illustrated banner, which makes a fine addition to illustrations in that line. This firm has over 300,000 horse-power of the "National" heater in use. They also manufacture large numbers of coils and bends of iron, brass and copper pipe, and their facilities have been severely tested this winter to keep up with their orders. They have recently made an addition of a building, 17x40 feet, to their plant, and have in contemplation a number of other improvements to be made during the summer.

A Philadelphia dispatch says: "Financiers in Philadelphia, Boston and New York are quietly at work placing stock for a strong Anglo-American syndicate, which is being formed to absorb the United Gas Improvement Company of this city. About three months ago English capitalists sent agents to the United States to investigate the plants and property owned by the company, estimate their value and earning power, and ascertain how the business of the concern could be extended and increased with larger capital. The report of the investigating agents was so satisfactory that the deal was recently consummated, the Englishmen assenting to the terms proposed by the Philadelphia owners. The amount of capital of the new concern will be $50,000,000, of which $30,000,000 will be called in at the start."

An Augusta (Ga.) dispatch says: "William E. Jackson, a well-known lawyer of this city, has solved the jute bagging problem that has agitated cotton circles for so long. Mr. Jackson has perfected mechanical appliances for making bagging from the cotton stalk, and he has just returned from New York with a roll of bagging. Expert cotton men say that it is in every respect equal to cotton bagging. He will utilize the bare stalks from the fields, and can afford to pay about two dollars a ton laid down. An annual stalk yield will bale three years' cotton crop. The machinery comprises heavily weighted corrugated rollers, with vats of running water, carding machines and bagging looms. It is estimated that, in making bagging from cotton stalks, two millions of dollars annually will go into the pockets of farmers for what is now cleared from the fields at an expense. Augusta will be the headquarters for the company's mills and offices, which will extend from Virginia to Texas. Mr. Hill had the roll of bagging, which is exhibited, woven by the jute bagging looms of Mr. J. C. Todd, at Paterson, New Jersey, and that expert pronounces it equal to its jute rival. The cotton stalk bagging is less inflammable, and is only a shade darker than jute. Cotton circles here are jubilant."

The Jos. Dixon Crucible Co., Jersey City, N. J., send us a two-leaf circular relating to "Dixon's traction belt dressing and leather preservative." Amongst other things, they say of this dressing: "It is the custom of many owners and superintendents to use nothing on their belts, but, when the belts slip, to tighten them up. This, however, heats and wears the journals, consumes the lubricating oil, and does not remedy the trouble of slipping. Weight, we know, increases journal friction, and the tightening of a belt acts just the same as would the adding of dead weight to the journals. The tighter the belt is made the surer it is not to slip, but it is impossible to tell how much additional work it and the power plant have to do when made too tight. There is a certain amount of elasticity in all good leather belting, but time and continued hard work weaken it, and the application of soap, resin, tar, tallow and castor oil, is simply an injurious and temporary stimulant which tends to destroy the vital energies and shorten the natural life of the belting. Dixon's belt dressing and leather preservative saves the life and elasticity of the belt to a most wonderful degree, and, as it completely prevents slipping of the belt, no power is wasted, and the greatest economy secured. Slipping belts means loss of power, and loss of power, of course, means additional cost."

The Beginning of Woolen Manufacture in this Country.

Thomas Schofield, of North Lyme, Conn., who will be one hundred years old next year, was one of the pioneers in manufacturing woolen cloth in this country. He is a native of Yorkshire, England, and was an infant when his father John and uncle Arthur emigrated to this country. At that time England prohibited the exportation of machinery, and the two men built in Charlestown, Mass., one of the first, if not the first hand loom and spinning jenny for use in an American woolen mill. Before the year was ended their machinery was running in Charlestown and Newburyport.

In the following year they started their first extensive business in Byfield Parish. Later, when they removed to Montville, Conn., Thomas and his brother James had grown old enough to help in the factory, and eventually to take charge of it. Their uncle Arthur located near Pittsfield, and he offered to merchants of that place his first piece of American broadcloth. It was grey mixed goods. No one would buy, and it was sent to New York and sold there. A few weeks after, Josiah Bissell, a leading Pittsfield merchant, made a trip to New York and brought back two pieces of "imported cloth," exactly like Schofield's. He sent for the latter, to show him "cloth that was cloth." His feelings may be imagined when Schofield showed him on the cloth his own private marks. It was the very cloth he had less than a month before rejected.

In 1808 Schofield manufactured thirteen yards of black broadcloth, and presented it to President Madison. From it his inaugural suit was made. Thomas established the first satinet factory in Connecticut, and was actively employed until he retired, six years ago, at the ripe age of ninety-three years, to rest from his labors. They had not always brought the reward to which he was entitled.

Once he met with reverses and lost all his property, but with the family pluck he began again at the bottom, and worked out of his troubles. One chief cause to which may be ascribed this result, as well as his great age, is doubtless found in his cheery statement: "I never worried much." In his one-hundredth year he is hale and hearty, with undimmed mind and sight.

Aside from $10, which he paid when a boy of ten for having a leg set that had been caught and broken in the gearing of the mill, he has not in his whole life paid over $4 for personal doctor's bills. To-day he claims he could earn wages sorting wool with

New Hand Drill.

the best of them did he have to. He has chewed tobacco seventy years, is chewing yet, and has always taken a drink when he needed it. His needs never led him to abuse the bottle.

Only one thing has occurred in recent years to disturb the even tenor of his temper. It was when a rival nonogenarian was written up in a local paper as the oldest citizen in that county of aged men. "The chicken!" fretted Schofield, when he read it; "he ain't within six months of my age."—*Hartford Times.*

New Hand Drill.

The accompanying illustration is of a small hand drill, intended to be held and used in one hand only, for drilling small holes, countersinking, or any similar operation requiring a rapid rotary motion of a small tool. There is a small spindle, to which the fly-wheel is attached, and this is driven by means of a gear-wheel and pinion, the gear-wheel being fixed on the end of a shaft, which is turned by a crank worked by the fingers of the hand applied to the small plate shown at the left of the cut. Thus, by repeated contraction of the fingers, small drills or other tools are driven at high speed, and can be used in an efficient manner by one hand only. The manufacturers are Tinius Olsen & Co., Philadelphia, Pa.

Some Notes of Travel.

By W. H. Booth.

I suppose all travelers form their own idea of the special feature of any country which they see for the first time. Here, in Holland, my own idea, formed on coming through from Rotterdam to Amsterdam, was that the main purpose of the Dutch people must surely be to keep their heads above water. Very much of the country, indeed, is a long way below the mean level of the North Sea, and so numerous are the canals and dykes and minor water-courses that the impression readily forms that the waterways have been made to obtain material to form any dry land at all. My stay here so far has not been sufficient to enable me to see very much of Dutch engineering, and as my object is rather to see something of the canals and dredging operations here carried on, I have not paid much attention to the locomotives here. Many of the older locomotives are by the now late firm of Borsiz, and have long funnels and outside cylinders with the valve driven by a crank or arm overhung upon the wrist-pin like so many of the Continental engines exhibited last year at Paris.

To-day I have seen a locomotive by Sharp, Stewart & Co., of Manchester, on which was a little device which I have never yet seen on a locomotive. Projecting from the leading small wheel or one of the truck wheels was what appeared like a prolongation of the axle. It projected about three inches, and was grooved to take a small one-inch belt. This belt seemed to be driving an oil pump, but for what purpose I did not discern, and have it in mind to take further note if I can find one standing. Every building in Amsterdam rests upon a piled foundation. Many are of very large size, and there does not appear to be any difficulty in obtaining firm foundations in this way for important structures. Clearly, however, fewer or shorter piles are employed for small buildings and dwelling houses, for there seems scarcely a vertical wall face in the city. Houses lean to the street, from the street and sideways, in a most curious manner, reminding one of the town of Northwich, in England, which is sinking irregularly, owing to the brine pumping operations of the salt manufacturers. The buildings do not, however, seem to become dangerous. It is quite common to see pile engines at work in the streets, and in the Oamrak I saw a pile being driven for a new house. It was of red fir I should say by its appearance, and with the bark on it.

The pile engine was simply a sort of winch with a rope barrel, which had a disengagement clutch and a brake. The engine wound up the monkey, and on the release of the barrel the monkey descended, pulling round the rope barrel at a high velocity. The monkey did not fall free of the rope, and thereby lost much of its effect. The guides for the monkey were simply a parallel pair of smoothed round poles. The pile sank very freely, and steamed at its head, which was bound with an iron ring. In plan, the City of Amsterdam is about a half of a polygonal figure, the various canals lying parallel to each other in the form of a series of polygons, one within another, with numerous radial canals and irregular branches which serve to make the city fairly confused unless one walks with a compass as guide. As a result there are many lift bridges, and in going about one finds the street with its tram-rails rising before one's face to open a passage for a barge or other vessel. These lifting bridges are in two half leaves, with a balance arm, and do not appear to call for much effort to raise them on the part of the one man to each leaf who puts a box key into a hole in the street, and walks round with the lever at top. Over larger canals bridges swinging on vertical pivots are employed.

A large piece of work is on hand here in the shape of a ship canal from Amsterdam in the easterly direction towards Utrecht. Down to a certain level, at least, it appears to have been constructed by hand labor, and in parts only now commencing large num-

bers of men are at work with spade and barrow. These men are regular ditchers, like their class in the fens of Lincolnshire, England, which are also so largely below mean sea level. They appear to possess, and of course do possess, special knowledge in their own work, and set out in such a manner that by leaving little strips here and there they get out the stuff to a considerable depth before water puts a stop to them or pumping is required. In many localities where the level of a bit of land is required to be raised they use the pump dredger. The buckets of an ordinary ladder dredge deliver their spoil into a large centrifugal pump attached to the side of the vessel and drawing in water below, which is discharged mixed with the dredged material through many hundreds of feet of piping about 20 inches diameter, and in sections of about seven meters in length. These pipes are floated on small rafts made of iron boxes or American petroleum barrels and jointed by leather. A light dam is thrown up round the area to be filled up, and the dredged material, mixed with from four to ten times its bulk of water, is simply pumped in, an outlet for water being provided at the most distant point from the inlet. In spreading over the whole area, the water deposits its load of sand or clay, and comes away fairly clear. The workmanship of the machinery is good and substantial, and, though considerable power is absorbed by the pump, the process must be far cheaper than conveyance by barges, and transfer from barge to land.

I have not learned yet if there is a law against the dumping of material dredged into deep sea, but should suppose there is, for there is no material to spare in Holland.

In the city of Utrecht, to which I went a few hours ago, via Breukelen (?) Brooklyn, there is a huge brick and stone tower, probably 300 feet in height, and built in two lengths of rectangular tower, the upper one being reduced in section, surmounted by an octagonal length, at top of which is a belfry containing forty-two bells. If the metal founders of England and America would set out to discover the secret of casting bells of similar tone—timbre is the proper word, I believe—they might land themselves in a large field of after employment.

The bells one hears in Holland have a quality eminently different from anything I heard in Anglo-Saxon parts. However, what induced me to mount this tower was not the "proclivities of the goat" to ascend to the highest point, as I once read in an American journal was an Englishman's characteristic, as it appeared to the writer when he tried to explain the top outside seats on our tramcars, which we prefer to being hung on a hand-strap with seventy-three others *inside* the car, as is the case in *New* Amsterdam. My cause for ascension was to view the engineering of these forty-two silvery toned bells. I found them hung round a frame, and the tongue of each bell which struck the bell inside its rim was attached to a horizontal wire, the other end of which was fixed to a piece of the framing or some bar.

From the horizontal wire hung a vertical wire which was attached to a wooden lever, one end of which worked on a pivot, and the other end of which was a handle. The operator pressed down the handle, and so caused the hammer to strike the bell. I suppose there would be forty-two such handles forming the key-board about four feet from end to end. Two operators worked the handles, and, being Saturday, I had the advantage of seeing their performance, which takes place on this day from 11 to 12.

Further below is the Carillon machine, which plays, of course, with less fine touch than the human machine. It consists of a large iron barrel about 54 inches diameter by about 48 in length. It is pierced about every two inches of its circumference with square holes in line about $\frac{5}{16}$" or $\frac{3}{8}$". Into these holes pegs carrying detents can be fixed, and the detents engage the levers of the bell wires, which hook into a screwed end for adjustment.

The speed is regulated by a large fan fly, and very accurate adjustment of "time" seems possible. The contrast with the Carillon of Manchester, England, or the soul-destroying tunes (?) rung out from the town hall of Bradford, Yorkshire, is painful to one's patriotism. I put this on record, as I spent five weeks solid in Bradford last fall, and could not find out what tunes were played. It was too funny.

Though sand seems to be the chief source of railroad ballast here, the roads are specially smooth and in good order, and suit well the English locomotives, which appear to be the favorites here. I cannot say much for the carriages. They are similar to the French, worse than any in Ireland, and infinitely inferior to those on even the South-eastern of England, and the other lines in and south of London, and that is saying a good deal. I have tried all their three classes, and speak only of the third class above, as it is by this class that people in the mass travel. The second class are very good. In the third, smoking seems to be universal, the idea being evidently, as in U. S., that if you can only afford third class you must stand being smoked upon. In this respect England leads, decidedly. Despite the shortness of the carriages they ran smoothly. There are, of course, no grades of any account here, and the prevailing type of passenger engine seems to be the four wheels, coupled, with sometimes a single leading wheel and at others a four-wheeled truck. I hope to see some of their pumping engines before I leave the country. One I am told of has a single large cylinder working eight beams radiating from the cylinder as a center, and working eight buckets. This, I believe, assists to drain the old Haarlem mere. There are proposals under consideration for draining all or a part of the Zuyder Zee. If carried out, this will be an immense undertaking. No American should omit Holland when visiting Europe. I believe many do.

An interesting piece of mechanical engineering to be seen near Amsterdam is a large pumping station for raising water about 1.50 m. into the higher level of the sea. The means employed are scoop wheels driven by treble-geared engines.

These scoop wheels are eight meters in diameter—about 26 feet—and 3½ meters wide. They revolve about three times a minute, and will each raise 200 cubic meters of water per minute. The aggregate capacity of the eight wheels was given me as 100,000 meters cube per hour. They are in sets of two, connected by a clutch coupling, so that one or both may be run, according to conditions. Two sets of two wheels are driven by two pairs of vertical engines, and the other two pairs of wheels by two pairs of horizontal engines working compound, and running at about 200 revolutions. All the wheels were stopped at the time of my visit, and the engineer and myself could only communicate through a third intermediary. The work in the brick casing is very carefully executed, the huge wheels revolving only 5 mm. clear of the breastwork, so as to lose as little water as possible. Such wheels seem eminently suitable for lifting large volumes of water through a small elevation. The wheels appear to require a diameter about five times the difference in level of the water, and are, I believe, not very well suited to work through a great range of height of lift. Near this pumping station is in course of construction a large double sluice of several openings. Between, runs, or is to run, the new Rhine Canal. To the Zuyder Zee open out one set of sluices with each a double set of lock or swing doors opening seawards only. The outer doors close an opening of about eleven meters in width, and are about seven meters high, the main timbers being of oak about 18"x15," with intermediate timbers, iron straps and cover boards fully 2" thick, with an outer sheathing of ¼-inch. These are the outer sea doors. A few meters inside there are other similar swing doors as reserves against stormy weather, and again inside are the shut-down slides working in grooves in the masonry, and operated by a winch above.

Next comes the canal, and across that a repetition of shut-down sliding door, and one pair of swing doors opening into the canal from the land dykes. Everything is very solid and substantial. One only wonders whence comes the money to carry out such great works which other countries are able to dispense with. It says much for the energy of the Dutch people that they carry such a load so easily. Possibly the facilities for water carriage go a long way to compensate for their expenses. As an illustration of the enormous amount of timber put out of sight as piling in this city, I may cite the King's Palace, which stands upon 13,659 piles on a square called the Dam. The Dam is the business center of Amsterdam, and takes its name from the fact that about 500 years ago it really was *the* dam, and outside the dam was the sea. Now it is far inside the city. The railroad station now stands on the water's edge—indeed, upon an island. It is an immense building, and has a large single-span roof which must be fully 300 meters in length, and is far in advance of any station in England in its general get up, glazed tiles entering largely into construction. I note here what I have only once seen in England, and that too in the Fens, that much of the brick-work here is built of very thin bricks, as much thinner than the American brick as that is than the English. They give a far better appearance to work. Having been here, I see or fancy I see the origin of many little traits and customs which seemed peculiar to me in America, and which, doubtless, are more or less survivals from the days when New York was New Amsterdam, and the inhabitants of Haarlem and "Breukelen" had been citizens of those same places in Holland. For example, the word "boss," always looked on in England as an Americanism, has its equivalent here in "Baas" the master. This should be a paradise for Americans. I am told that good cigars can be got for three cents each, and it takes five Dutch cents to make two American cents. There is no duty on the weed. There is little or no stone in the country, but granite is brought from Norway, and other stone of a hard, slaty variety for sluice work irom Germany, and for pitching and sluice aprons; there appears to be brought also from Germany short lengths of small basaltic pillars, similar to the columns forming the Giant's Causeway in North Ireland, only of smaller section. The pump dredger must evidently be found cheap and satisfactory to work. Since writing the first part of this letter I have seen hopper barges of dredged clay brought to the top ground, and in place of being carried out of the barges by the usual elevator, the stuff was dumped close in shore near the nose of a dredge, which picked it up again and delivered it by its pump through floating pipes upon the land as already described. Though it seemed like doing work twice over, yet in the end it would be cheaper, as the whole of the work would be done by steam, no handling or moving of the stuff to the elevator buckets being required.

A chain ferry runs from Amsterdam across to the other side of what forms this end of the North Sea Canal. The chain is picked up from the bottom, and, in addition, a 1¼" inch wire rope serves as a guide to the boat, being probably tighter than the chain. There does not seem much chance for such a ferryboat getting astray in foggy weather.

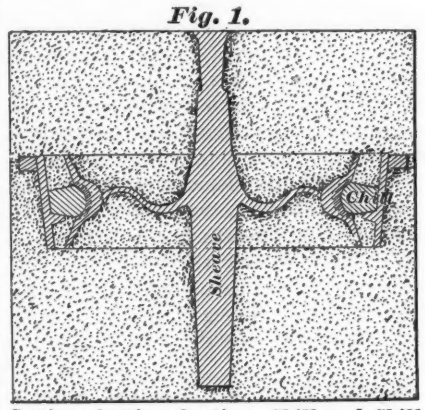


Fig. 1.

Section showing Casting, Chill and Chill Seat in the Sand.

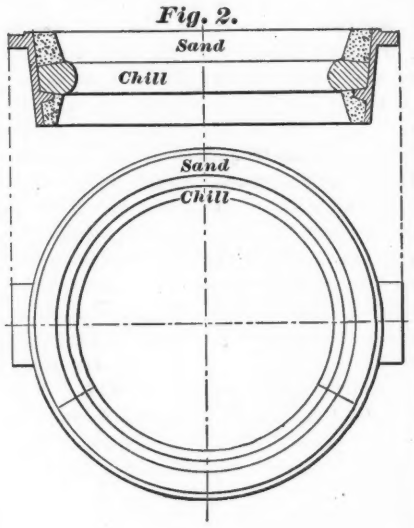


Fig. 2.

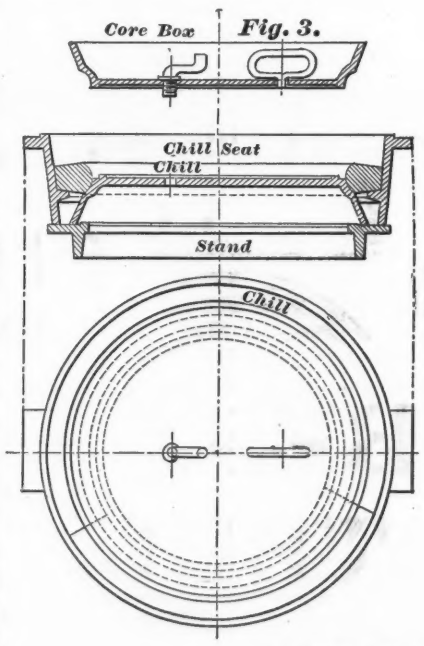


Fig. 3.

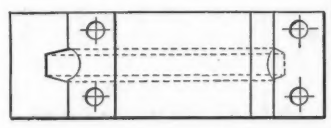
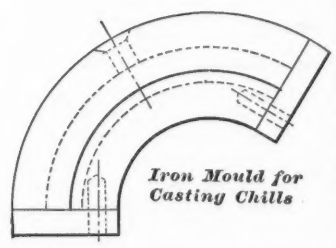


Fig. 4.



DEVICE FOR CASTING SHEAVES.

Device for Casting Sheaves.

We herewith give illustrations of a device for moulding and casting chilled sheaved pulleys. This invention has been put into practical use; with it, from 5,000 to 6,000 sheaves have been made up to date in the establishment of F. M. Davis, manufacturer of mining and milling machinery, Denver, Col., and it is claimed that the entire rig is at present as good as new. The illustrations are so plain that an extended description is unnecessary. Fig. 1 shows the pulley in position in the flask with chill and chill seat. Fig. 2 represents a section and plan of chill seat, chill and sand for forming the face of pulley. Fig. 3 represents a section and plan of the core-box, chill seat, and chill in position to be rammed with sand. Fig. 4 shows an iron box, in which the chills are cast to save the expense of turning.

The pattern of the pulley is made plain with taper to equal that of the chill seat, thereby insuring a true fit in the mould.

Mr. Alfred Cordingly, 1354 South 10th street, Denver, Colorado, controls the use of this device.

All I Know About Johnson.

About five years ago I got off for two days to visit a neighboring town. I went there to see what I could in other engine-rooms than my own. An engineer who never looks outside his engine-room, or those right around him, gets fossilized, as it were, and it had been so long since I had been outside the boundaries of Backaway that I seriously thought I recognized the approach of petrifaction.

In my lookings around I went into—from an outside view—about the hardest looking engine-room I ever saw, and it was evident that at some time not long before the inside of that engine-room had looked as bad as the outside. There was evidence of much recent patching of floors, not done by a carpenter, and a cheap picture—it wasn't of a prize-fight—tacked on the wall covered, as I afterwards learned, a hole that wasn't patched. There was paint, evidently not spread by an artist of the brush and paint pot. But everything, even to the rather ancient engine, was clean in its ugliness. There was a sort of recent sprucing up, as if company was expected. I took all this in at a glance, as, by certain means known to the craft, I put myself on good terms with the engineer, whose name I soon found was Johnson.

When I went in Johnson was puttying up cracks in the brick foundation. Inquiry brought out the fact that he had only been running there three months, and, as he put it, had "just patched up a little, mined into the engine, borrowed a paint pot from the painter, and given her a coat of paint. She isn't striped, but she looks better than she did before."

Johnson spoke cheerfully of other improvements he should make as time rolled on; in fact, he spoke rather enthusiastically of how comfortable he would make things in a few weeks.

I rather liked Johnson from the start, and now I felt sorry for him. My engine-room at Backaway isn't as good as some I have heard of, but I thought I could go home fairly contented; probably shouldn't do much grumbling for a month.

Johnson asked me through the apology for a doorway—cautioning me to stoop—into the boiler-room. It wasn't much of a boiler-room as boiler-rooms go, but there were no ashes under foot, and no straggling lumps of coal to step on. A newly painted boiler front, and other evidences of tidying up were visible—no leaky joints or pipes.

Going back into the engine-room I noticed that the cylinder was drilled for an indicator, and mentioned it to Johnson. "Yes," he said he had "heard the boys talk indicator a good deal at the association meetings for the past two years, and finally some one lectured on the subject. I got interested, and thought I might learn how to use the indicator, so when I came here I bought one—a good deal of money for a fellow who works for small wages—and drilled the holes at night; and now I practice with it a little."

Johnson went to a little apology for a cupboard—home-made, he said—in the corner, and took out some cards. "There," said he, "is the first pair of cards I took. I knew from what I had heard said at the association and by the lecturer that they were way off, but what the matter was beat me. I took them up to the next meeting, and some of the boys gave their opinions about them, but, as their opinions differed, I made up my mind I must invest in a book on the subject; I bought the book, and for the past three weeks I have worked away at the old engine, until now I get this." Here he showed me some cards that, with my limited knowledge of the subject, I knew were way ahead of the first ones.

"I don't," continued Johnson, "know anything to speak of about using the indicator yet, but I rather think I'll learn."

I went away from that engine-room pitying Johnson.. I could see that he was a bright young fellow, working and studying hard, and it seemed that things must be out of joint when he was cooped up in that little tumble-down hole, with an engine that ought to be in the scrap heap, and no repairs to the building—or to much else—except what he made himself. I contrasted his situation with my own where I had been twenty-five years; not getting very big wages, to be sure, but having everything comfortable—luxurious compared with him; new engine a year ago, not a real first class engine, to be sure, but one that kept going without giving trouble, and engine-room new inside. Still I thought for some time how Johnson was working to improve things, and how he kept his old rookery and his old scrap heap of an engine cleaner than I kept my comfortable room and new engine.

Last week I went to the same town, and my first effort was to call on Johnson. I opened the door of the same old engine-room, and saw a stranger where I expected to see Johnson. The stranger didn't respond to any tokens of recognition. The poor old engine was pounding and wheezing along as well as it could under its load of machinery, and grease, and neglect. The picture was torn from the hole in the wall, and dirtiness was supreme.

Somehow it didn't occur to me that Johnson was away for good; I thought he was away for a day or two, and had got a brother throttle puller to take his place. I thought if I saw him I would say "I told you so" (I don't think I did, but that never matters in such cases). Thought I would tell him that I knew he could never stick to his intention of keeping things clean and respectable in such a hole as this. I really believed that he had become discouraged, and let things fall back into their old course.

I inquired from the man who was rattling around loose in the place Johnson filled when I was there before, when the latter would be around. "Won't be around here," said he, "he's been gone a year and a half; gone to the big new mill under the hill to run the 800 horse compound. Got a carpet on the floor, a mahogany desk, nickel-plated indicators, lots of fixings, some one to do the work while he bosses around. Don't shovel coal any more, Johnson don't. And he didn't even apply for the job. You see Johnson got it into his head that the boiler here wasn't safe; the old man wouldn't get it repaired, so he quit, and the next day—two months before the big mill started—they hunted up Johnson to go and help in putting in the engine and take full charge after it was started. Just Johnson's luck."

I thought I saw further into the matter, and also saw a chance to become a missionary without traveling for it. So as an opener I ventured to remark that the place didn't look as well as it did when Johnson was there. "No, I don't have things to do with same as Johnson has at the big mill. Johnson was a blamed fool to putter away all his blessed time on these old traps. Nobody thanked him for it, and they are just as well suited at the way I keep things. Give me a place same as Johnson's got, and see what I'll do." I saw missionary work wouldn't count here, and I went away wondering if Johnson was a "blamed fool," or if the other fellow would keep things in order in the big mill.

I went away directly to the big mill and asked for Johnson. He came, and together we went to his engine-room. It was a surprise to me—it was there, carpet, mahogany desk and all; it was there, big compounds and boiler-room clean enough to eat dinner in; it was there, with Johnson just as modest as ever, and just as determined to make things look and *be* as nearly right as circumstances would permit as he was when he was in the little break-neck engine-room at the other end of the town. I went through the mill with him, and saw all the machinery in his charge, and the facilities at his command. I went away very reluctantly, but this time I didn't pity him. I didn't go away thinking, like the other fellow, that Johnson was a "blamed fool" for making the best of things in his old place, or that the other fellow could hold a job at the big mill

---

Mr. Editor, I know the American Machinist does not print many stories, even if they are true. But whether you print this one or not, it is all I know about Johnson.

Joel Oldone.

Mechanical Engineers' Meeting.

The spring meeting of the American Society of Mechanical Engineers will be held at Cincinnati, Ohio, May 13 to 16. Important papers will be read and discussed.

It is said that minute variations in the lengths of different metallic bars are determined by the vibrations of a wire connected with a calipering device. The tension of the wire determines the number of vibrations, as in a piano wire or a violin string.

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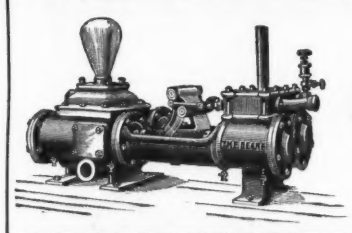

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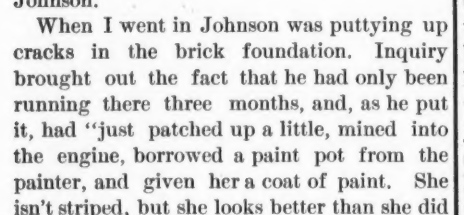

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The steamship "City of Berlin" recently landed in New York, and, in a very natural haste to discharge her cargo, began doing so before the entire roll of official tape had been unwound. Then a tremendous tempest in a teapot followed. Finally the steamship was allowed, under certain bonds, to make the return trip, subject to confiscation or something terrible when she returns to this port. And the men who were so unfortunate as to have goods unloaded—without their knowledge, of course—if they were valued at more than $1,000, find themselves in the position of not being able to get them except after a deal of trouble and heaven only knows what fines and penalties. The enforcement of the custom laws of the United States seems to be after the manner of "how not to do it."

A good many signs point to a belief that the days of gathering stores of ice from filthy ponds and rivers are about numbered. Refrigerating machinery and artificial ice-making machinery, by the use of which comparatively pure ice may be had, will, beyond much doubt, before long take away the employment of the ice cutter. The old idea that water purifies itself in freezing has been pretty thoroughly exploded, and now it only remains for some fortunate inventor to bring out a machine which shall be cheap in price, and which will operate economically in making small quantities of ice, to knock the bottom out of ponds and rivers, so far as providing the cooling solid is concerned.

Pig iron is made in twenty-five States of the Union.

Machinists' Supplies and Iron.

NEW YORK, April 26, 1890.

Iron—American Pig.—In this and neighboring markets a fair amount of business has been transacted, and a little greater tendency is shown by consumers to stock up at present low prices. Still there is considerable evidence of greater production than immediate needs demand, which makes prices rule in buyers' favor.

We quote Northern brands No. 1 Foundry, $18 to $19; No. 2, $17 to $18. Southern brands No. 1, $17 to $17.50; No. 2, $16.25 to $16.50. But some orders have been placed at prices somewhat lower.

The amount of warrant iron in store has reached nearly 60,000 tons, and the price for warrants on the exchange has been $17 for all deliveries up to August.

Scotch Pig—The demand has been moderate, and warrants in Glasgow have an easier tendency. We quote Eglinton, $19.25 to $19.75; Dalmellington, $22 to $22.50; Coltness, $25.50 to $25.

Bar—We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2, for round lots on dock.

Copper—We quote Ingot, Cakes and Wire Bars at 14⅝c. to 14¼c. Common casting brands are somewhat easier, at 12⅝c. to 12¼c.

Lead—Values have recently shown a decided tendency to advance. Some large lots have changed hands during the week at 3.95c. to 4c., and 4.10c. to 4.15c. is now asked by holders for future deliveries.

Spelter—The market has ruled dull of late.

We quote Western ordinary brands, 4.95c. to 5.05c.; Choice, 5.35c. to 5⅜c.; Refined, 6¾c. to 7c.; Silesian, 6⅝c. to 6¾c.

Tin—There has been a sharp advance recently, though it is difficult to give a cause for it. In a jobbing way, dealers ask here 20⅜c. to 20¾c.

Antimony—Regulus Hallet, 19½c. to 20c.; Cookson's, 25c to 26c.

Lard Oil—Pressers' prices are 54c. to 54½c.

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"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Machinists Wanted—First-class vise and machine hands of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, Ohio.

Wanted—Good tool-room machinist on night force; five nights per week. Electric lights. Steady work. Apply, with references, to The Westinghouse Machine Company, Pittsburgh, Pa.

Situation wanted in N.Y. City or vicinity, by practical draftsman & machinist. Thoroughly posted in power transmitting machinery, also designing special machines. Address R., AMERICAN MACHINIST.

Wanted—Competent sup't for machine tool shop of about 30 hands. State experience, reference, and expectations. Replies will be treated confidentially. Address Machine, AMERICAN MACHINIST.

Wanted—Position as engineer by a young man with best references, used to pumps and hoisting engines. Can do repairing and pipe fitting. Address A. T. Mulvany, Fairmount, Ill.

Wanted—A position as foreman by a first-class tool maker, machinist and draftsman. 2½ years as foreman in shop making the very finest of tools for interchangeable work. Age, 35 years; sober and industrious. Box 10, AMERICAN MACHINIST.

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Wanted—In one of the Middle States, a thoroughly competent designer on light machine tools and automatic machinery. Must be familiar with modern methods and shop practice. State positions held formerly, and give references. Address Box 7, AMERICAN MACHINIST.

Sup't wanted by a large manufacturing concern in a large center working iron and wood—chiefly the former. Must be a thoroughly educated mechanic and a draftsman, energetic, exp'd, and competent to handle large numbers of men. Young man pref'd. Give full exp., refs., and age. Box 6, AM. MACH.

Engineering Correspondent Wanted—Correspondent exp'd in heavy machinery, and capable of obtaining data on which to base orders, preparing proposals and submitting information to customers. Address, stating age, exp., refs., and compensation expected, Correspondent, Box 5, AM. MACHINIST.

Young man with four years' experience in steam pump shop wishes situation in a good general shop where he can have a chance to improve; willing to work for it. Cares more for improvement than wages. W. B. M., care AMERICAN MACHINIST.

Wanted—1 first-class draftsman, 3 first-class pattern makers, 15 first-class machinists experienced on engine work, and 15 first-class moulders. No second-rate men wanted, as we manufacture only high-grade work. Good wages and steady work to the right men. Address Sioux City Engine Works, Sioux City, Iowa.

Wanted—A live man for sup't. Must be a practical machinist; one who knows how work should be done, and can manage men and machines successfully on piece-work basis. Work—agricultural engines and machines, and general work. State age, experience, and salary expected. Address Box C. Schenectady, N. Y.

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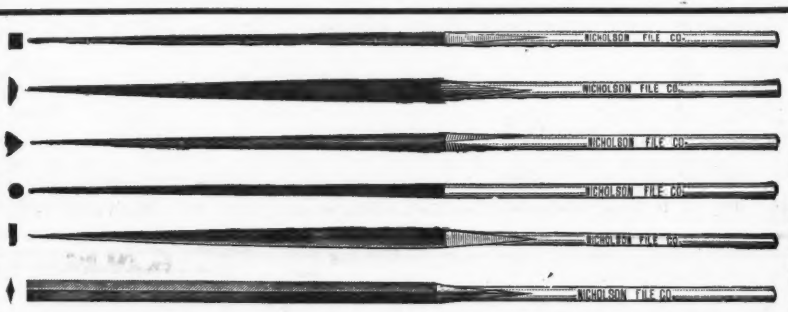

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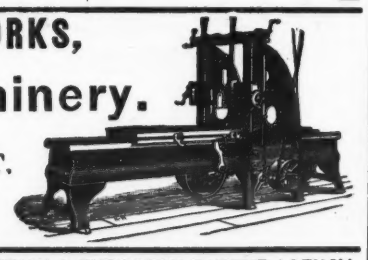

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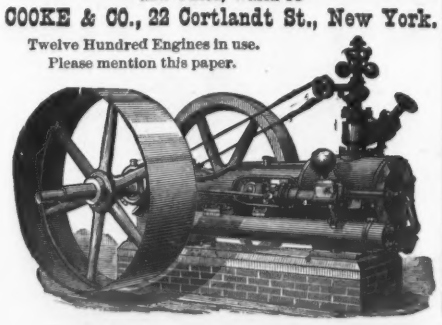

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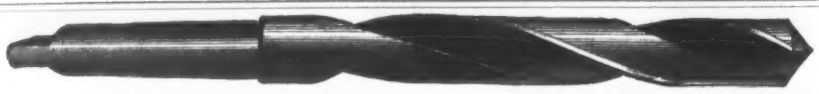

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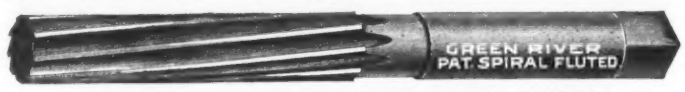

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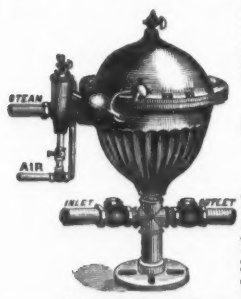

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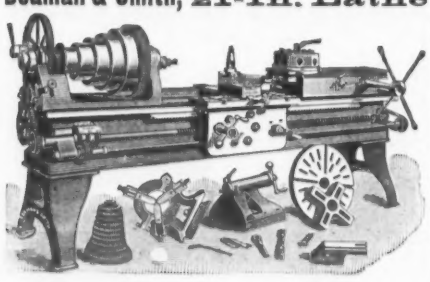

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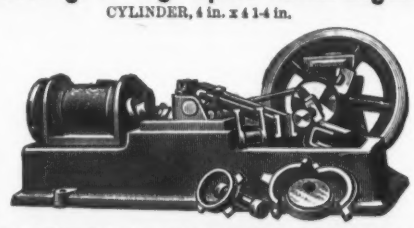

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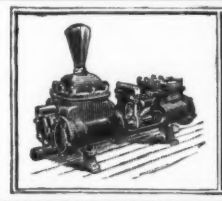

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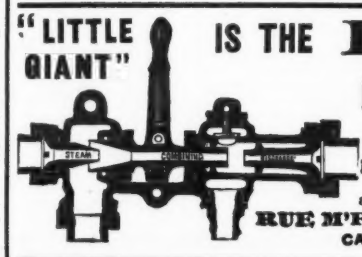

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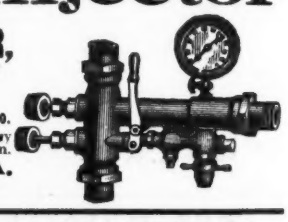

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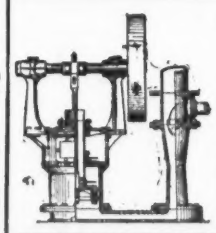

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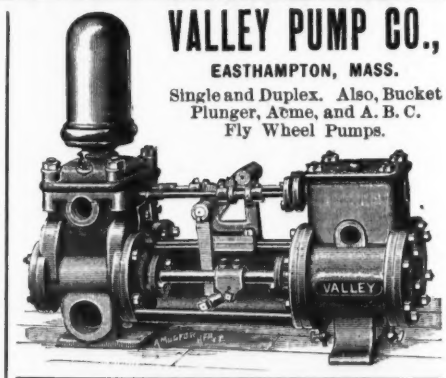

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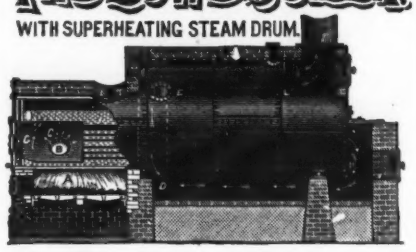

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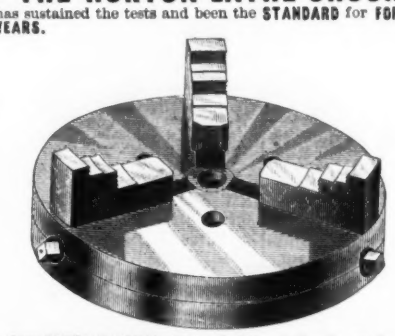

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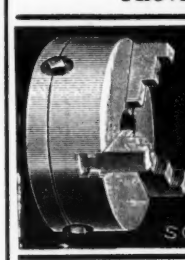

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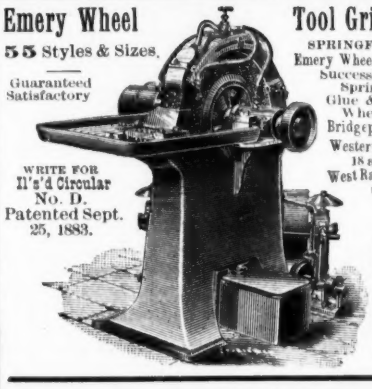

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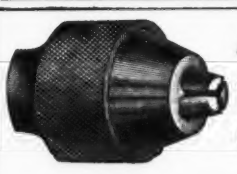

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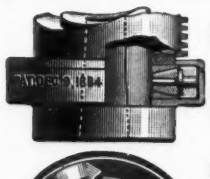

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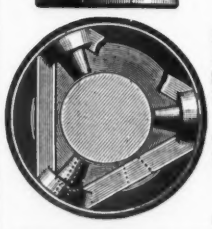

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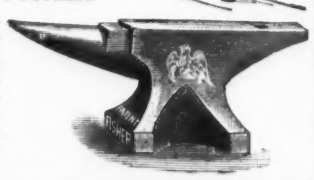

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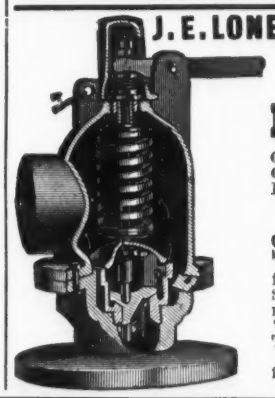

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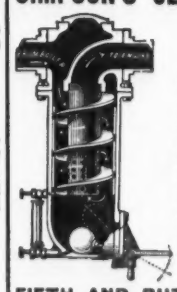

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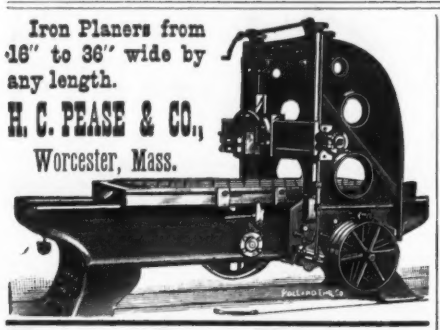

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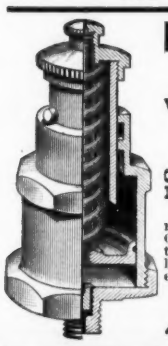

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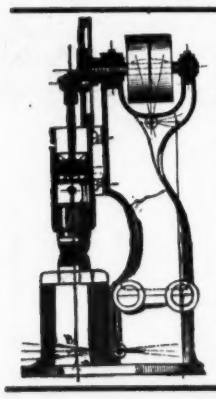

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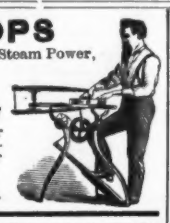

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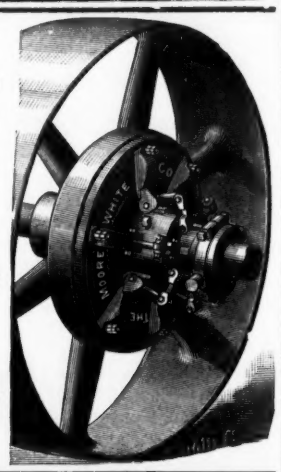

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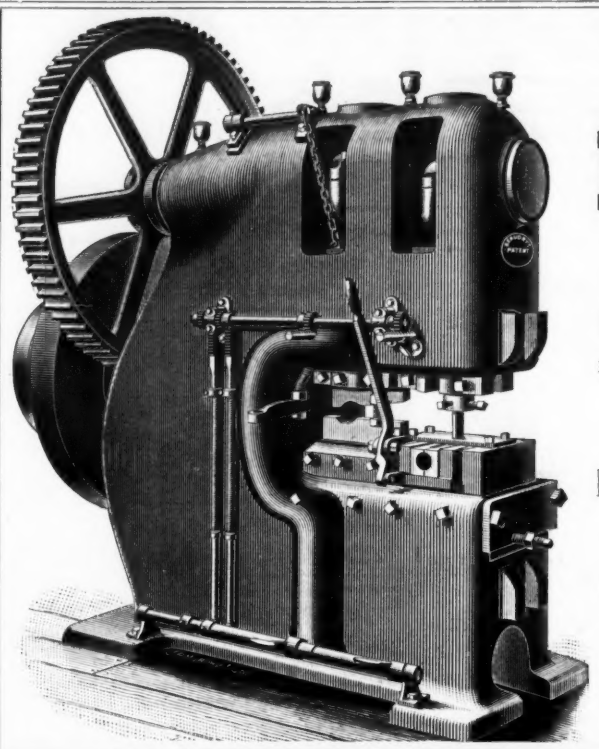

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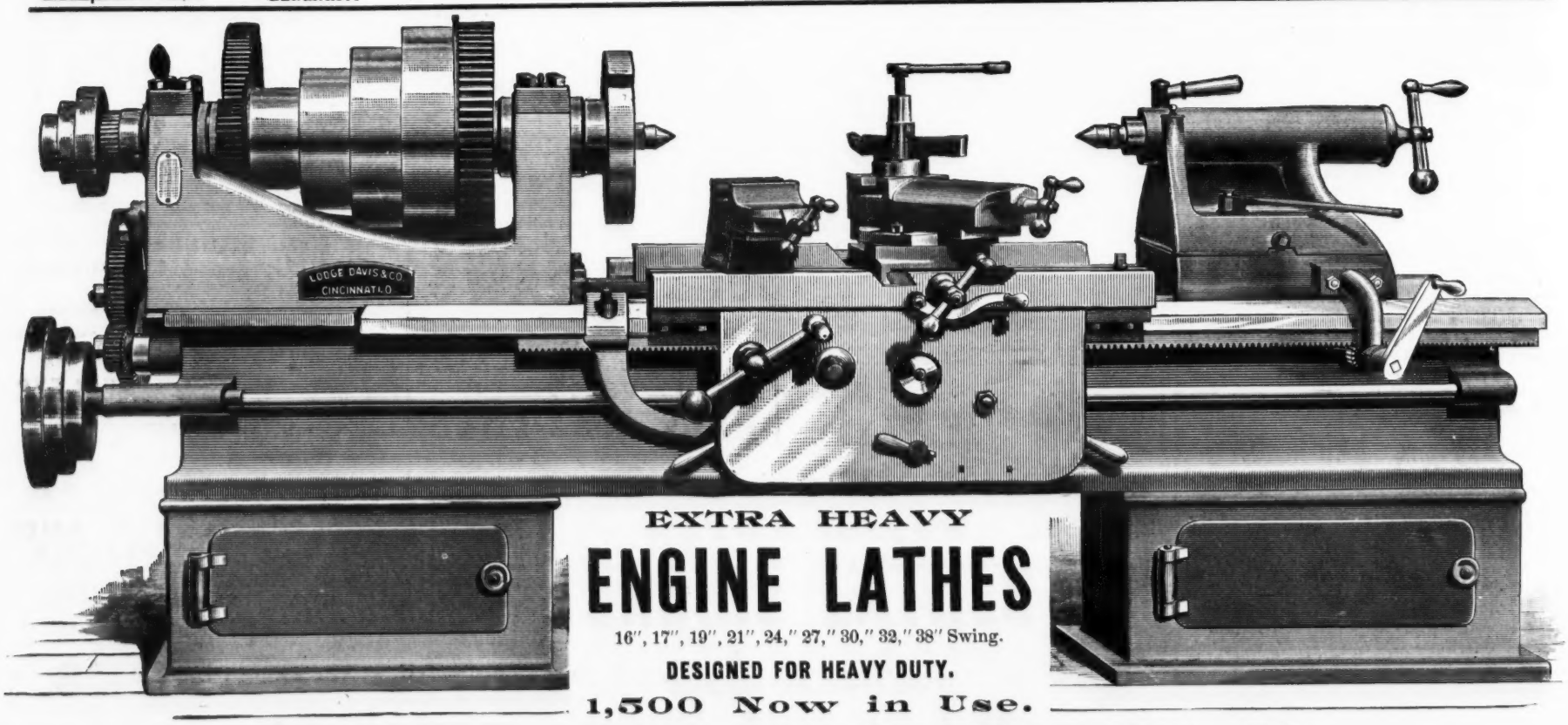

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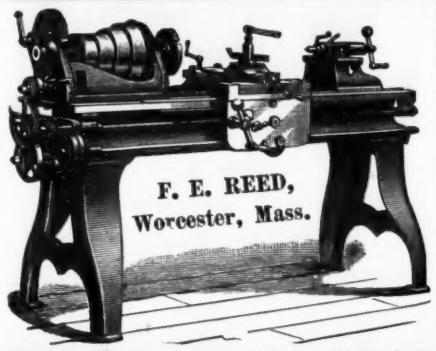

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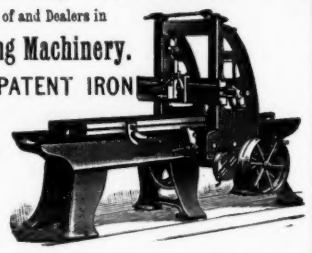

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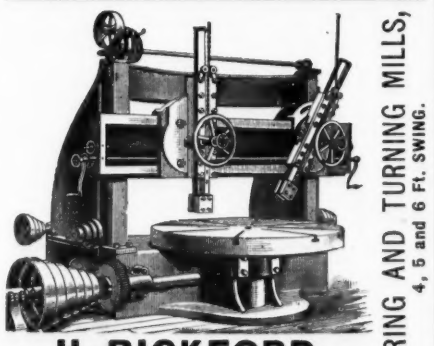

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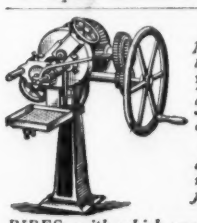

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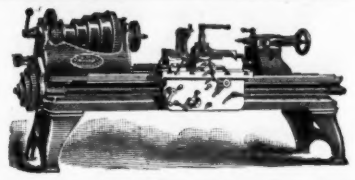

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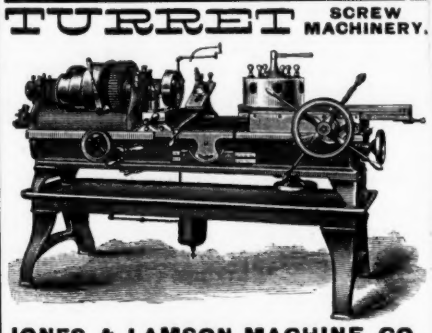

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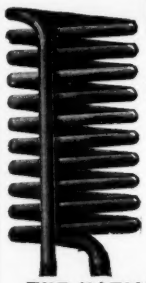

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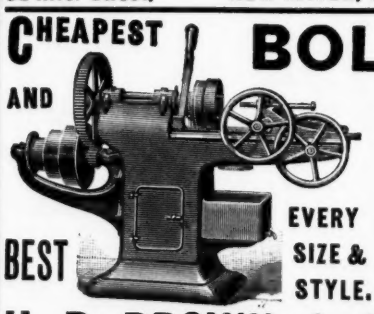

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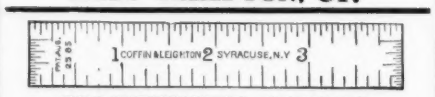

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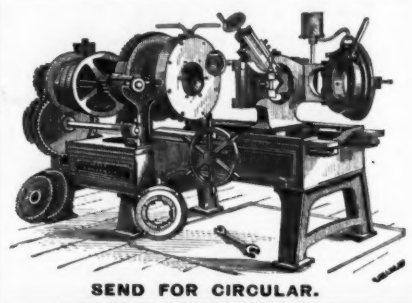

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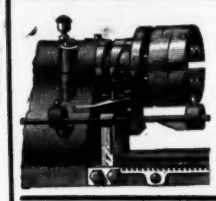

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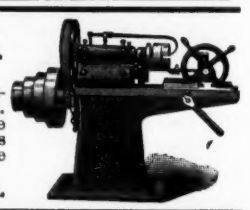

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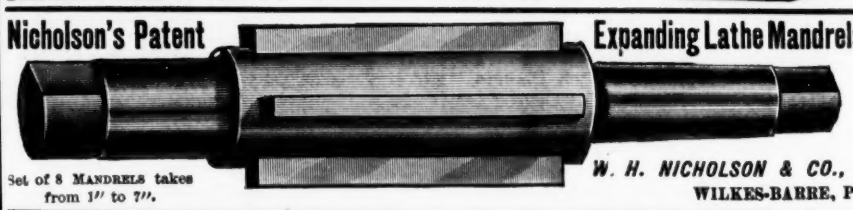

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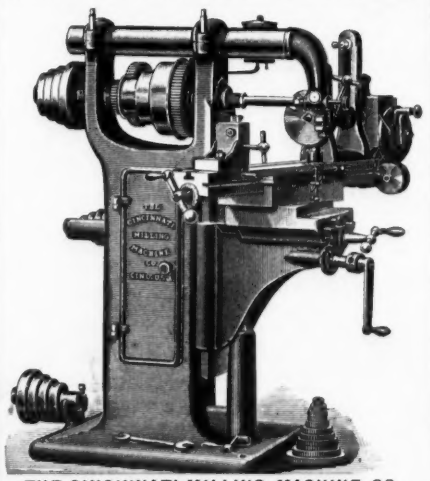

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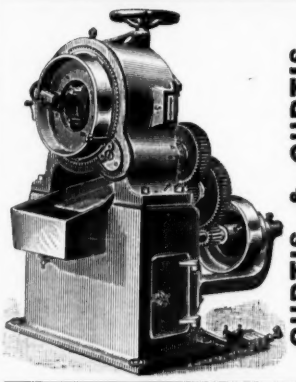

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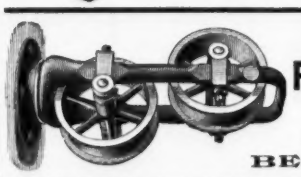

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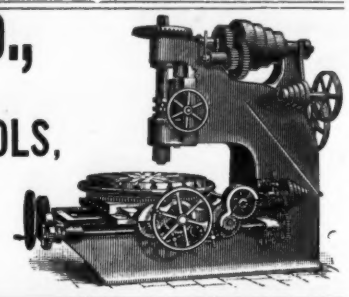

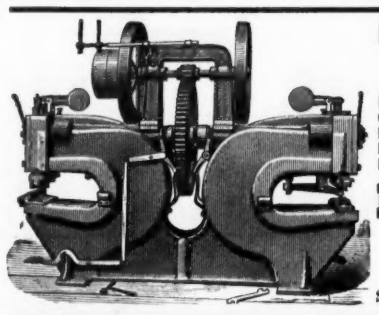

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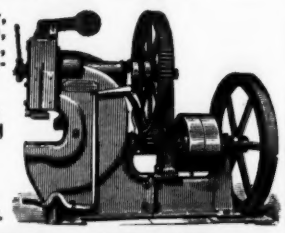

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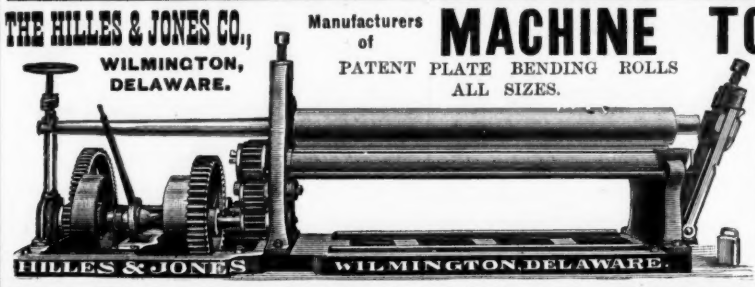

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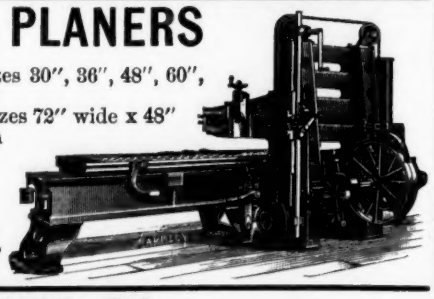

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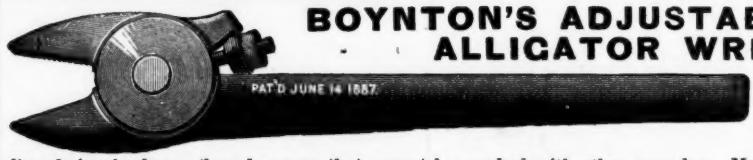

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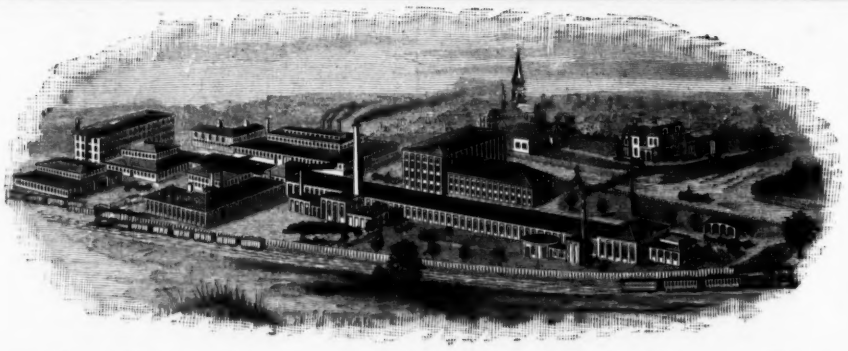

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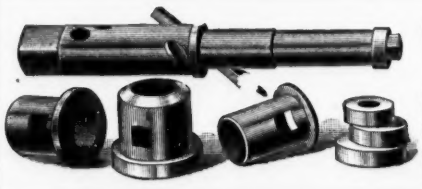

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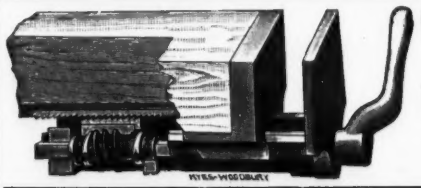

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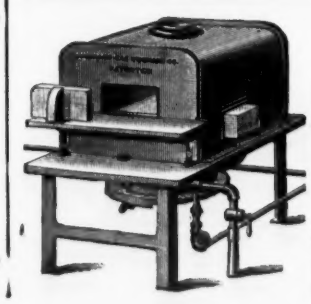

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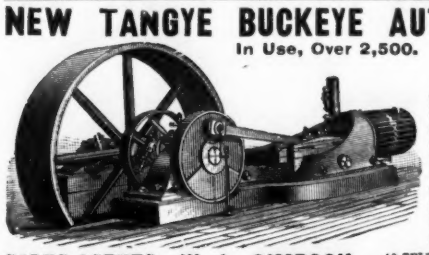

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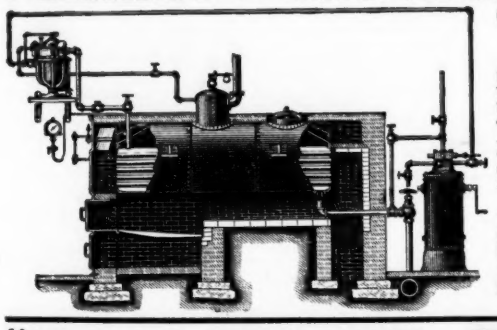

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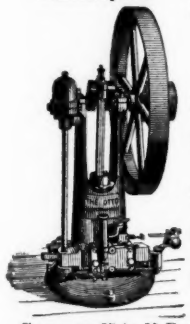

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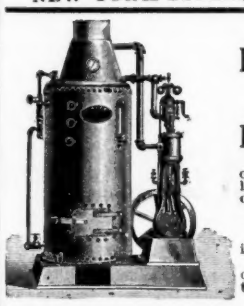

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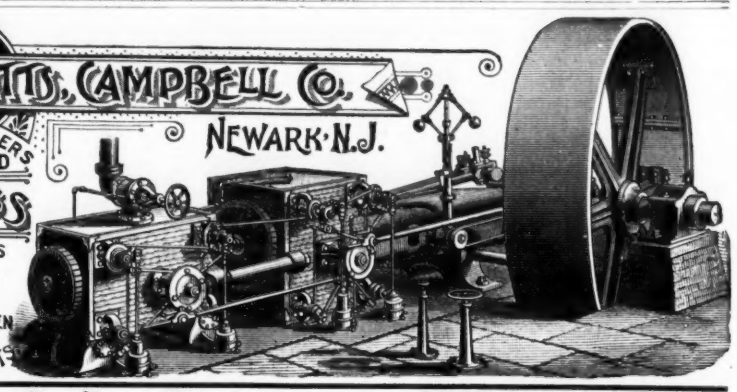

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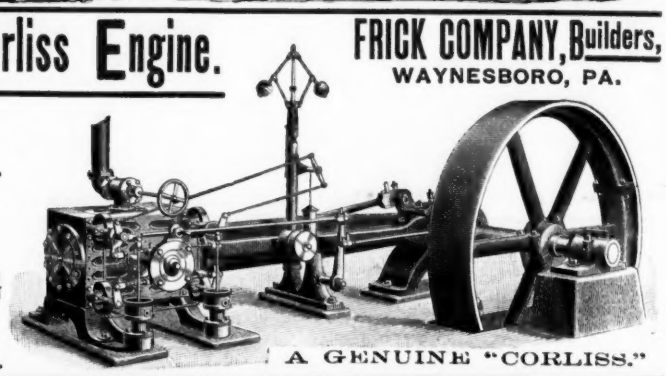

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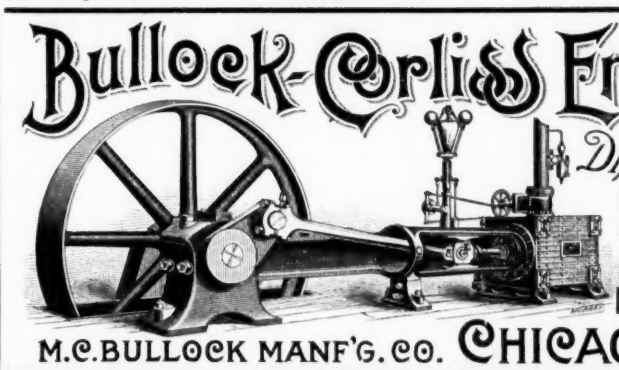

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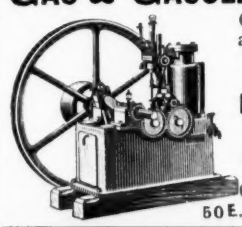

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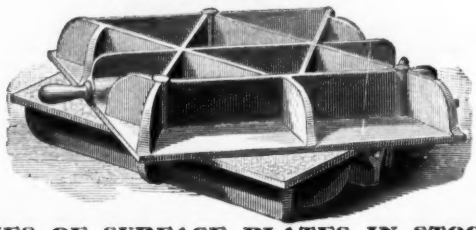

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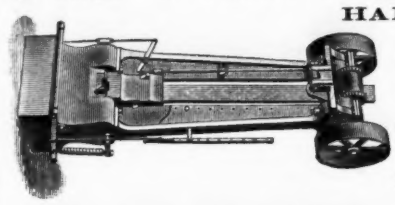

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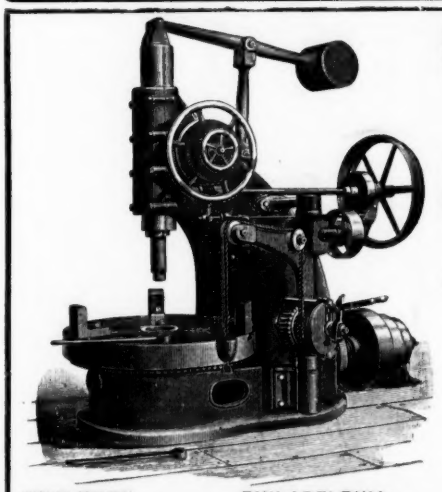

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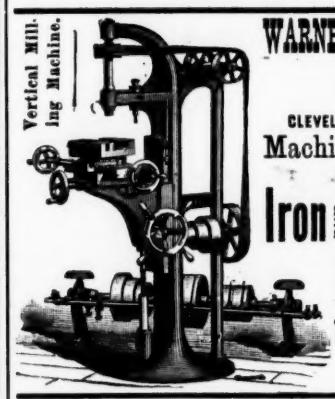

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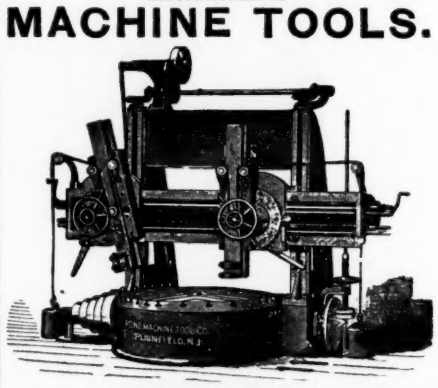

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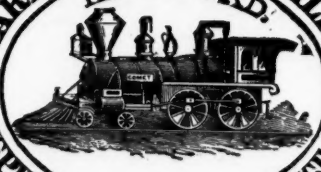

J. M. ALLEN, President.
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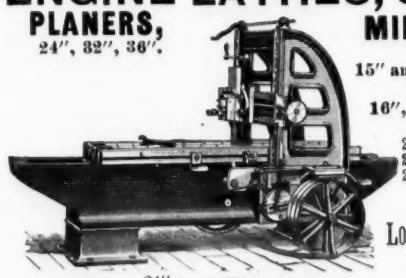
ENGINE LATHES, SHAPERS & DRILLS.

PLANERS, 24″, 32″, 36″.



24″ PLANER.

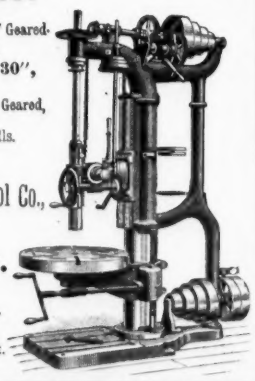
MILLING MACHINES.

SHAPERS, 15″ and 20″ Crank, 20″, 26″, 32″ Geared.

ENGINE LATHES, 16″, 18″, 19″, 21″, 24″, 27″, 30″, 32″ & 38″.

20 in. Upright Drills. 25 in. Back Geared, 24 " " " and 28, 32 and 40 inch Power Feed Drills.

THE Lodge & Davis Machine Tool Co., Manufacturers of



IRON & BRASS WORKING MACHINERY.

WORKS, CINCINNATI, OHIO.

Write for prices; it will pay you. Special attention given to complete outfits.

NEW YORK, 64 Cortlandt St. CHICAGO, 68 & 70 S. Canal St. BOSTON, 23 & 25 Purchase St.

See Advertisement on page 16.

Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

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Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS, Rochester, N. Y.

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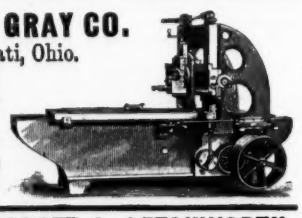
PLANERS AND LATHES A SPECIALTY.



WHAT our customers say about the

EBERHARDTS PATENT DRILL PRESS.

The only one built on correct principles.
More economical than any we have ever used.
Can do double the work. Most convenient.
Best in the market. Much admired.
No trouble or expense for repairs.
Could not ask for anything better.
There may be as good a one made by some one else, but I have not seen it.
I feel that I did wisely in buying your tool.
We consider it a model tool and fills the whole bill.

Below we give the names of a few who are using our Pat. Drills, Gear Cutters, Shapers, etc. Machines.

Missouri Pacific Railway Co., St. Louis, Mo.	3
Eames Vacuum Brake Co., Watertown, N. Y.	4
Carnegie, Phipps & Co., Pittsburgh, Pa	2
American Brake Co., St. Louis, Mo.	3
Worthington Pump Works, Brooklyn, N. Y.	8
King Iron Bridge Works, Cleveland, O	9
Filer & Stowell Mfg. Co., Milwaukee, Wis	3
Hutchinson, Hollingsworth & Co., England	8
Daft Electric Light Co., Marion, N. J.	3
Pratt & Whitney Co., Hartford, Conn.	8
R. Hoe & Co., New York City	11
Cooke Locomotive Works, Paterson, N. J.	9

Also, Standard Oil Co., Lima, O.; Morgan Engineering Co., Alliance, O.; Grand Trunk Railway of Canada, Montreal, Can.; Brainard Milling Machine Co., Hyde Park, Mass.; Boston Bridge Works, Boston, Mass.; Pond Machine Tool Co., Plainfield, N. J.; Niles Tool Wks., Hamilton, O.; Geo. A. Gray Co., Cincinnati, O. Write to

COULD & EBERHARDT, For Catalogue A. NEWARK, N. J.

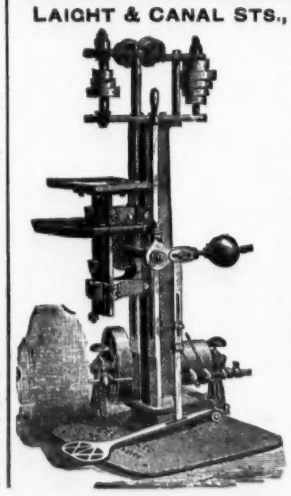
The Garvin Machine Co.,

LAIGHT & CANAL STS., NEW YORK,

Manufacturers of

Machinists' Tools,

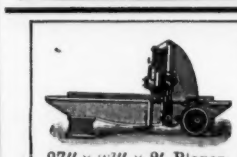
Including Milling Machines, Drill Presses, Hand Lathes, &c.



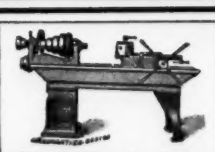
The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

STEEL CASTINGS.

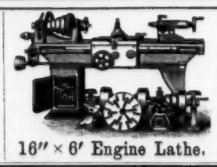
PRATT & LETCHWORTH, PROPRIETORS BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.



27″ × 27″ × 8′ Planer.



20″ × 6′ Chucking Lathe.

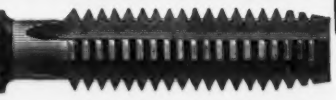


16″ × 6′ Engine Lathe.

25″ Pillar Shaper.

THE HENDEY MACHINE CO. TORRINGTON, CONN. MANUFACTURERS OF MACHINE TOOLS. SEND FOR OUR CATALOGUE.

J. M. CARPENTER PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES